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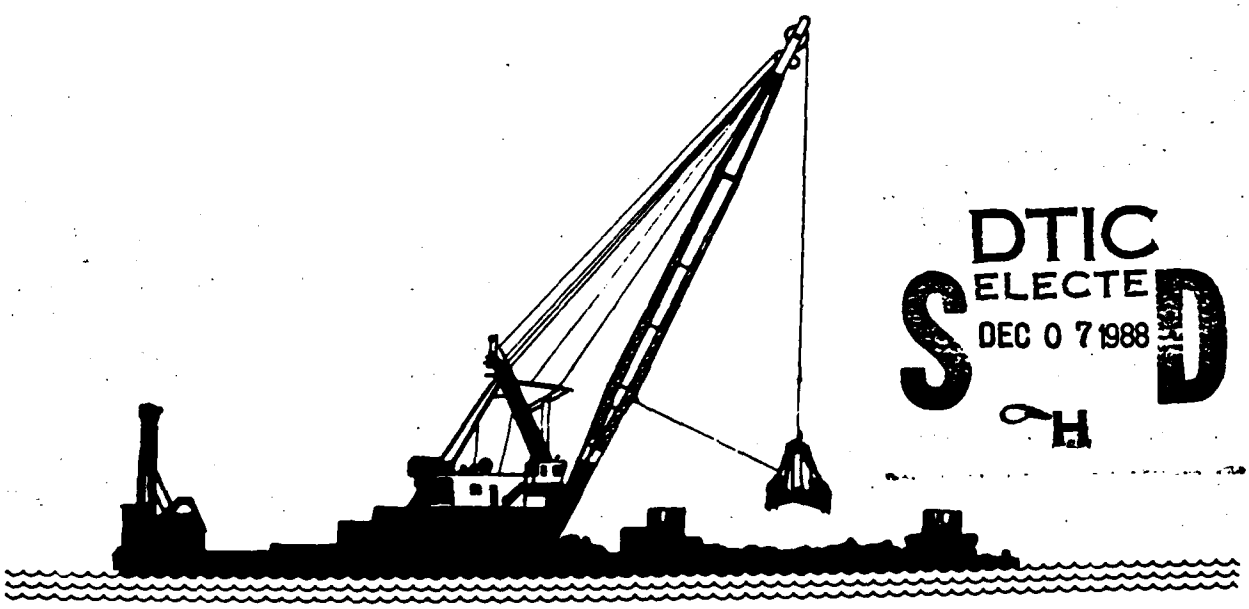
US Army Corps of Engineers
Seattle District

PSDDA Reports

Puget Sound Dredged Disposal Analysis

Washington State Dept. of Natural Resources

MANAGEMENT PLAN REPORT - UNCONFINED OPEN-WATER DISPOSAL OF DREDGED MATERIAL, PHASE I (CENTRAL PUGET SOUND)



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This final environmental impact statement evaluates alternatives considered in identifying preferred sites for disposal of dredged material in Central Puget Sound. Three public multiuser disposal sites (Commencement Bay, Elliott Bay, and Port Gardner) are identified for use based on a site selection process which considered several alternative sites. Alternative biological effects conditions for site management have been considered and a site condition identified for purposes of dredged material management at the Phase I sites.

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PUGET SOUND DREDGED DISPOSAL ANALYSIS
(PSDDA)

MANAGEMENT PLAN REPORT (MPR)
UNCONFINED, OPEN-WATER DISPOSAL OF DREDGED MATERIAL
PHASE I (CENTRAL PUGET SOUND)

U.S. Army Corps of Engineers, Seattle District
U.S. Environmental Protection Agency, Region X
Washington State Department of Natural Resources
Washington State Department of Ecology

June 1988

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THIS DOCUMENT CONTAINS THE
MANAGEMENT PLAN
FOR UNCONFINED OPEN-WATER DISPOSAL
OF DREDGED MATERIAL
PHASE I (CENTRAL PUGET SOUND)

BOUND SEPARATELY ARE THE FOLLOWING SUPPORTING TECHNICAL APPENDIXES:

DISPOSAL SITE SELECTION
EVALUATION PROCEDURES
MANAGEMENT PLANS

ALSO BOUND SEPARATELY IS THE
FINAL ENVIRONMENTAL IMPACT STATEMENT -
UNCONFINED, OPEN-WATER DISPOSAL
SITES FOR DREDGED MATERIAL, PHASE I
(CENTRAL PUGET SOUND) (NEPA/SEPA)

EXECUTIVE SUMMARY

This report contains the findings of Phase I of the Puget Sound Dredged Disposal Analysis (PSDDA), a comprehensive study of unconfined dredged material disposal in deep waters of Puget Sound. The study is being undertaken as a cooperative effort by the U.S. Army Corps of Engineers (Corps), U.S. Environmental Protection Agency (EPA), and the State of Washington Departments of Natural Resources (DNR) and Ecology (Ecology). A management plan for the Phase I area (central Puget Sound) is presented which identifies selected unconfined, open-water disposal sites, evaluation procedures for dredged material being considered for disposal at these sites and site management considerations including environmental monitoring.

PUGET SOUND NAVIGATION AND DREDGING

Navigation waterways of Puget Sound have played a vital role in the region's economic development and growth. Combined Port of Seattle and Port of Tacoma activity produces over 70,000 jobs and an annual business volume of nearly $4 billion. There are 34 port districts serving the region. Some 50 miles of navigation channels, about 50 miles of port terminal ship berths, and more than 200 small boat harbors must be periodically dredged to maintain the commercial and recreational services provided by these facilities. Over the period 1970-1985, an estimated 24.8 million cubic yards (c.y.) of sediments were removed from Puget Sound harbors and waterways by various dredgers. These included private developers and public entities (e.g., Federal and State agencies, ports, and local governments) responsible for funding and undertaking dredging projects. To place this activity in some perspective, periodic dredging for navigation improvement and maintenance projects occurred in only an estimated 0.08 percent or less than 2 square miles of the total 2,500 square mile surface area of Puget Sound.

PUGET SOUND DREDGED MATERIAL DISPOSAL

Historic Practice. During early development of Puget Sound waterways, dredged material was often used as a convenient source of fill material for associated harbor and terminal improvements. This practice has continued, but at a much lesser rate in recent years, as public policy has been to protect environmentally important tidal areas, wetlands, and marshes. Consequently, nearshore disposal options are limited. Upland disposal is quite costly and may also have adverse environmental impacts. In the future, for many projects, disposal in deep and relatively deep marine waters is expected to be a preferred option for environmental, as well as economic, reasons.

Public Unconfined, Open-Water Disposal Sites. Until 1970, dredged material disposal in Puget Sound was discharged at sites generally selected by each dredger. At that time, disposal site designation guidelines were formulated by an interagency committee chaired by DNR, and more than 10 specific public multiuser disposal sites were established. Nearly all unconfined, open-water disposal has since occurred at these sites. In the 1970-1985 period, about

9 million c.y. or approximately 36 percent of the total material dredged was released at the designated disposal sites with most of the remaining material used as an economic source of landfill even though much of it would have been acceptable for open-water disposal. When compared with the 250 to 300 million c.y. of sediment that were discharged by the rivers flowing into Puget Sound over this same period, it can be concluded that only about 2 percent of the total annual sediment loading was due to dredged material disposal from new projects. Maintenance dredging adds no additional sediment loading.

Key Regulatory Authorities. Section 404 of the Federal Water Pollution Control Act (FWPCA) Amendments of 1972 established a permit program, administered by the Secretary of the Army. This program is used to regulate the discharge of dredged material into waters of the United States. It also is used to specify disposal sites in accordance with Section 404(b)(1) Guidelines developed in interim final form by EPA in 1975. The Guidelines concentrated on specifying the tools to be used in evaluating and testing the impact of dredged or fill material discharges on waters of the United States. In 1977, the FWPCA was substantially amended as the Clean Water Act (CWA). In 1980, EPA, in conjunction with the Corps published final Guidelines for the specification of disposal sites for dredged or fill material. These specify that the disposal of dredged material must not result in an "unacceptable adverse impact" to aquatic ecosystems. Simultaneously, proposed rules for testing requirements were published. Although final rulemaking has not taken place, the testing requirements and procedures have been implemented by the Corps as a matter of policy.

Congress granted to the States the responsibility for certifying under Section 401 of the CWA that a proposed discharge, resulting from a project described in a Corps public notice issued under Section 404 of the CWA, will comply with the applicable provisions of the State and Federal water quality laws. This certification is required for any Federal activity, and from any applicant for a Federal permit to conduct any activity, which may result in any discharge into State waters. Compliance with Section 401 also ensures that any such discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA and relevant State laws.

Dredged Material Research. Considerable nationwide research has been accomplished since the early 1970's through the Corps' Dredged Material Research Program (DMRP) in assessing the environmental effects of dredged material disposal. This research has been used by the Corps in making decisions on dredged material disposal. DMRP has shown that most dredged material is suitable for open-water disposal and can have many beneficial uses, including fish and wildlife habitat development. As part of the DMRP, studies were conducted in Elliott Bay and elsewhere in Puget Sound. Puget Sound examples of beneficial use of dredged material include Jetty Island at Everett, clam habitat development at Oak Bay Canal, and a beach feed erosion control project at Keystone Harbor on Whidbey Island.

SITUATION LEADING TO PUGET SOUND DREDGED DISPOSAL ANALYSIS

Past Dredged Material Evaluation. Until 1984, Puget Sound dredged material sampling, testing, and test interpretation requirements were established on a project by project basis. EPA and the Corps, in cooperation with Ecology, assessed non-Corps dredging projects. The Corps conducted the evaluations for federally authorized Corps navigation projects. (For the purposes of this report, federally authorized navigation projects include Corps projects authorized under various River and Harbor Acts as well as all other federally operated channels such as Navy, U.S. Coast Guard, NOAA, etc.) In the case of Corps navigation projects, Seattle District developed testing procedures for each project in cooperation with Ecology and EPA. These procedures, developed programmatically for Corps projects, were also required, as appropriate, for non-Corps permit applicants.

Case-by-case evaluations did not provide local authorities with sufficient assurance that aquatic resources at the disposal sites were being adequately protected. The Puget Sound area is unique relative to other regions of the Nation in that local governments also play a key role in dredged material disposal through their shoreline master programs under the State shoreline permit process. Local jurisdictions can condition or restrict dredging and dredged material disposal.

The lack of fully consistent evaluation procedures, or specitic objective decision criteria led, in part, to the establishment of interim disposal criteria by EPA and Ecology for the Fourmile Rock disposal site in Seattle's Elliott Bay in 1984 and the Port Gardner site near Everett in 1985. The Fourmile Rock criteria became a condition of the local shoreline permit issued by the city of Seattle and the Port Gardner criteria a condition of the city of Everett permit for the existing Port Gardner site. Subsequently, in 1985, Ecology developed the Puget Sound Interim Criteria (PSIC) to ensure that the other Puget Sound disposal sites did not experience similar problems. These criteria have been used in the interim pending development of regional Sound-wide guidelines for dredged material disposal.

Closure of Disposal Sites. The Fourmile Rock and Port Gardner disposal sites were closed in 1984, due in part to public controversy associated with use of these particular locations. While the Fourmile Rock site was reopened in 1985, it closed again in June 1987, when the shoreline permit for the site expired. The Commencement Bay site closed in June 1988. Accordingly, there are currently no unconfined, open-water disposal sites available in the Phase I area. This condition creates uncertainty with regard to future disposal of dredged material and highlights the urgency of having an acceptable dredged material disposal management plan, if maintenance of navigation channels is to continue.

Puget Sound Pollution and Contaminated Sediments. The past practice of discharging untreated or only partially treated industrial and municipal effluent into Puget Sound, combined with potentially harmful chemicals from a variety of other point and nonpoint sources, has resulted in the degradation over time

of the water and sediment quality in some areas of Puget Sound. Increasing scientific evidence about the harmful effects of pollution on the estuary has served to heighten public and agency concern about the long term environmental health of the estuary and the impact that various activities can have on the Sound's ecosystem. Recent efforts to establish better regulatory control of pollutants at their source have resulted in general improvements in water quality. Additionally, ongoing planning and cleanup actions by the Puget Sound Water Quality Authority (PSWQA), Ecology, EPA, local governments, and others are expected to further improve the marine environment. Concerns remain, however, because the sediments near industrialized and developed areas may remain contaminated from past waste discharge practices. This is because potentially harmful and persistent chemicals tend to bind to the sediment particles and settle to the bottom. While considerable improvements have been made, more remain to be accomplished.

Data indicate that pollutants, which have entered the major harbor areas through various sources, have accumulated over time in a variety of shoreline areas, including navigation channels and vessel berthing locations. Dredging, in the process of maintaining the Sound's navigation system, must sometimes involve the removal and disposal of contaminated sediments.

The PSDDA study has recognized the requirement for dealing with contaminated sediments. However, the study focus has been primarily on disposal of the majority of dredged material which is expected to be found "clean" or uncontaminated, and therefore acceptable for unconfined, open-water disposal at designated public multiuser sites. These are locations where any dredger can dispose of dredged material, provided that the material has been evaluated and disposal approved by the appropriate regulatory agencies. A separate study by the State of Washington is underway which will address the specific requirements of dredged material found unacceptable for disposal at the PSDDA designated sites.

PUGET SOUND DREDGED DISPOSAL ANALYSIS (PSDDA)

Environmental and economic considerations are both major factors supporting the need for long range regional planning as a lasting, effective solution for dredged material disposal problems. No longer can disposal alternatives be planned independently for multiple projects in a given area. Regional dredged material disposal management programs offer greater opportunities for environmental protection, reasonable project costs, and greater public acceptance than total case-by-case decisionmaking. A dredged material disposal management plan for unconfined, open-water disposal has been developed through the PSDDA study. This plan is unique to the Puget Sound area because the data supporting many elements of the plan are Puget Sound based. Also the plan reflects the social values of this region and is responsive to the unique role, from a national perspective, of local government in the management of open-water dredged material disposal sites.

Study Scope. The Corps, EPA, DNR, and Ecology began the PSDDA study in April 1985. The study is a 4-year-long effort being conducted in two overlapping

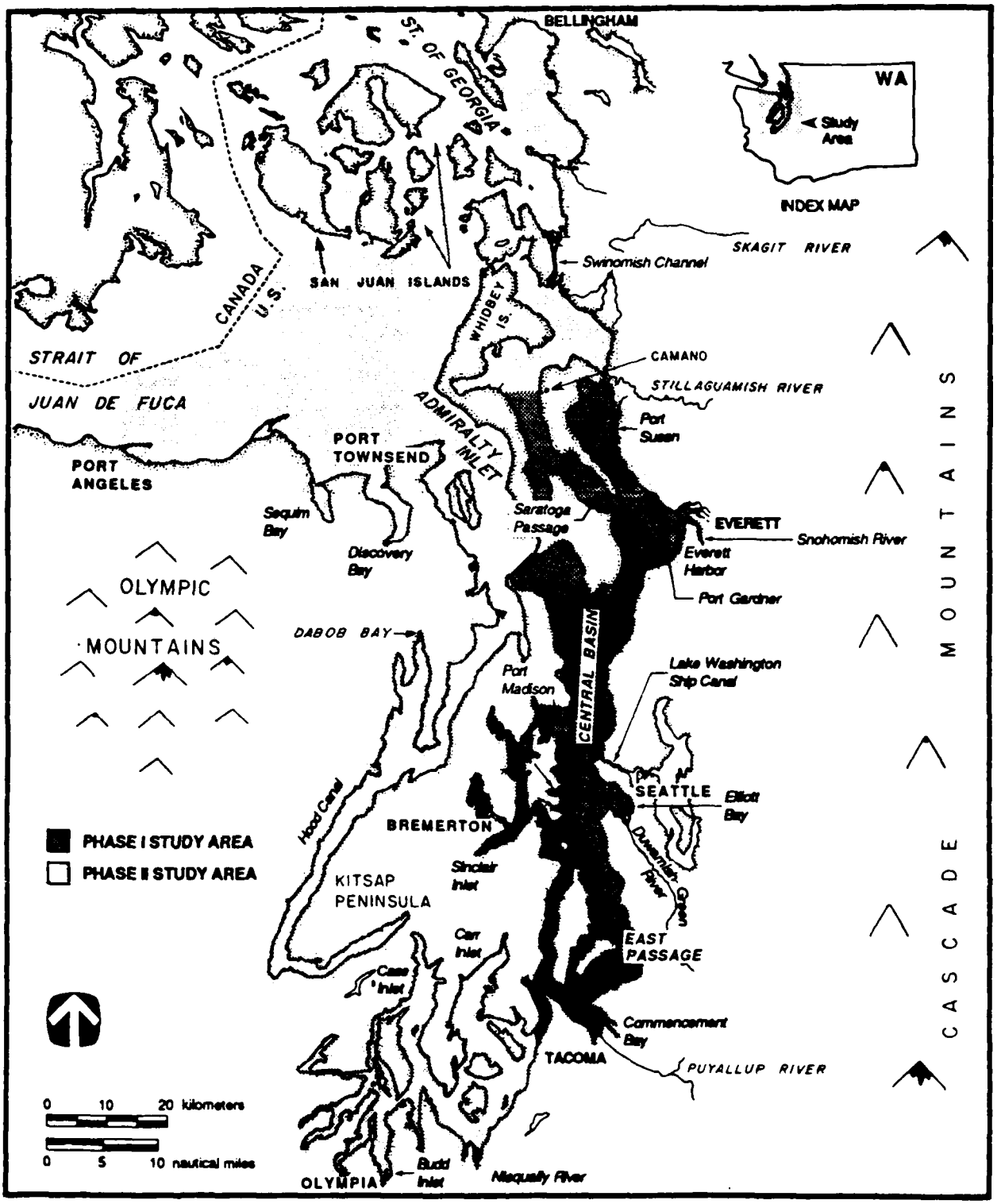


Figure 1. Study area -
Puget Sound Dredged Disposal Analysis

phases, each about 3 years in length. As shown in figure 1, Phase I covers central Puget Sound, including the Sound's major urban centers, Tacoma, Seattle, and Everett. Phase II, initiated in April 1986, covers the north and south Sound areas, including Olympia, Port Townsend, Port Angeles, Anacortes, Bellingham, and other locations of dredging activity. Separate Phase II documents will be prepared and distributed during the fall of 1988 for public review and comment.

Study Goal and Objectives. The goal of PSDDA is to provide publicly acceptable guidelines governing environmentally safe unconfined, open-water disposal of dredged material, thereby improving consistency and predictability in the decisionmaking process. Public acceptability involves consideration of a wide range of factors. Among these are technically sound evaluation procedures and practicability, which includes cost effectiveness. Study objectives are to: (1) identify acceptable public multiuser unconfined, open-water disposal sites; (2) define consistent and objective evaluation procedures for dredged material to be placed at those sites; and (3) formulate site use management plans that will ensure adequate site use controls and program accountability.

Study Limitations. Although PSDDA is identifying specific disposal sites and site management plans for unconfined, open-water disposal, locations for conventional upland/nearshore sites and confined disposal sites (confined aquatic or upland/nearshore) are not being specified via PSDDA. There are several reasons for this. First, while disposal in Puget Sound revolves around many regionwide and State-wide issues, disposal on land (especially for contaminated material) is very much associated with local government decisions regarding land uses. Second, the authorities of the various agencies involved in PSDDA are not as easily applied to land. And last the State of Washington, in a recently initiated study, is addressing confined disposal options and associated testing procedures, building on the work done through PSDDA.

An evaluation comparing the potential impact of dredged material disposal to the impacts of other water-related activities in Puget Sound is also beyond the scope of this study. However, due to the limited areas to be dredged and the conditions imposed by regulatory agencies, dredged material disposal at unconfined, open-water sites has very little potential for affecting the overall ecosystem of Puget Sound. This conclusion is supported by information derived from the PSDDA study and presented in study documents.

PSDDA PHASE I (CENTRAL PUGET SOUND)

Study Findings. The following are key findings of the PSDDA study for the Phase I area:

- About 22.7 million cubic yards (c.y.) of bottom sediments could be removed from Phase I area harbors and waterways over the period 1985-2000 as compared to the 16.8 million c.y. removed between the years 1970 to 1985.

- A management plan has been prepared that addresses the needs of unconfined, open-water disposal including (a) disposal site locations, (b) site

management conditions, (c) dredged material evaluation procedures, (d) disposal site management, (e) disposal site environmental response monitoring, and (f) dredged material data management.

o The management plan for the Phase I area meets the PSDDA goal and accomplishes each of the study objectives.

o Specific project by project evaluations, to be made under the Section 404(b)(1) Guidelines and Section 401 Water Quality Certification review, will establish actual dredged material volumes that can be placed in unconfined, open-water disposal sites. However, through the year 2000, based on PSDDA projections and estimates, about 11.2 million c.y. of future dredged material is expected to be found acceptable for unconfined, open-water disposal. This compares with 6.8 million c.y. of dredged material actually placed in Phase I waters over the past 15 years. In the past, not all acceptable material was placed at public disposal sites. Much was used for landfill or other beneficial purposes. This is anticipated in the future, too.

o The PSDDA preferred disposal sites can accommodate the projected volumes of acceptable dredged material well beyond the year 2000.

o More extensive dredged material sampling and testing will be required than in the past, as well as improved disposal site management, including increased permit compliance inspections and environmental monitoring of site impacts. Overall, the cost of dredged material disposal is anticipated to be higher than it was prior to the establishment of the EPA/Ecology interim criteria, but less than that experienced under the interim criteria. More dredged material is expected to be found acceptable for unconfined, open-water disposal under PSDDA evaluation procedures as compared to the interim criteria. Other disposal options, including confined aquatic capped, nearshore, and upland disposal are generally much more expensive because of greater handling and transport requirements, and the increasing difficulty in securing acceptable site locations. From a regional standpoint, the reduced disposal costs are expected to more than compensate for increased costs of sampling, testing, and disposal site management.

o Environmental consequences were considered as various elements of the management plan were addressed. This is reflected in the locations chosen for the selected disposal sites, as well as the biological effects condition chosen for site management. Environmental impacts resulting from disposal at the preferred sites are not expected to be significant, as discussed in the PSDDA Phase I FEIS.

o The PSDDA plan, while unique to the Puget Sound area, fully complies with the Clean Water Act and its objectives to restore and maintain the environmental quality of the Nation's waters. Also it is intended to be in consonance with all applicable State and Federal laws and the PSWQA-adopted 1987 Puget Sound Water Quality Management Plan.

o Indian treaty fishing rights are addressed as part of the PSDDA process.

Management Plan. Key elements of the PSDDA management plan for the Phase I area are:

o Public Multiuser Unconfined, Open-Water Disposal Sites. Three public multiuser unconfined, open-water disposal sites have been selected which will partially satisfy the future dredged material disposal needs of the Phase I area. Because the Phase I area contains the major urban and industrialized centers of development where significant waste discharges have occurred, only about 60 percent of this area's future dredged material may be found acceptable for unconfined, open-water disposal. This compares with 90 to 95 percent nationally. The estimate of acceptable material for the Phase I area is based on existing, primarily surface sediment data, which reflects areas of higher contamination. Actual volumes may be more or less, and will depend on test results and subsequent evaluations by regulatory agencies. Unacceptable material will need to be confined in aquatic capped, nearshore, or upland facilities. For some projects, the high cost of confined disposal may preclude their undertaking. This has a potential for adverse economic and social impacts as many projects are important to local communities as well as the region.

An unconfined, open-water disposal site has been selected in each of the Tacoma, Seattle, and Everett urban embayments of Commencement Bay, Elliott Bay, and Port Gardner, respectively. The sites, while varying in size primarily due to bathymetry, average about 350 acres in potential bottom impact area. Each site includes a 900-foot radius, 58-acre surface disposal zone within which all suitable dredged material must be released.

The selected disposal sites are all located in areas relatively free of important biological resources and human use activities. Particularly valuable and unique resource areas were avoided. The center of the Commencement Bay preferred disposal zone is located approximately 1 mile west of Browns Point, in water about 550 feet deep. In Elliott Bay, the center of the preferred disposal zone is located about 3/4 of a mile north of Harbor Island, in water 265 feet deep. The center of the Port Gardner preferred disposal zone is located about 2-1/4 miles southeast of Gedney Island, in approximately 420 feet of water.

o Site Management Condition. Alternative site management conditions were evaluated in recognition that some environmental impacts may be associated with use of the disposal sites. These management conditions relate to the potential for long-term chemical effects that might be allowed on biological resources, due to dredged material disposal. Short-term physical impacts that will occur due to burial, are accepted as part of site use. The selected management condition for the Phase I sites could allow up to "minor adverse effects" on biological resources that may be present or move across the disposal sites. However, because only acceptable sediments will be discharged at the disposal sites, the aggregate condition of each site is expected to be substantially better than allowed under the selected management condition (Site Condition II).

o Evaluation Procedures. Comprehensive dredged material evaluation procedures governing sampling, testing, and test interpretation (disposal guidelines) have been developed through PSDDA to ensure that conditions at the disposal sites are consistent with site management objectives. The evaluation procedures are intended to be used, as appropriate, in support of assessments of specific projects conducted under the Federal Section 404(b)(1) Guidelines and under the State of Washington guidelines used in evaluating projects for Section 401 Water Quality Certifications.

o Site Management Plans. Disposal site management plans have been formulated to address navigation and discharge conditions of disposal permits, and subsequent disposal site environmental monitoring. The monitoring plan is intended to ensure that acceptable conditions at the site are not exceeded and to provide a basis for any necessary plan adjustments.

Alternatives. The Final Environmental Impact Statement (FEIS) accompanying this report describes and evaluates the selected and alternative disposal sites. Also discussed are alternative biological effects conditions considered for disposal site management. A No Action alternative, which would continue use by Ecology and EPA of the PSIC for dredged material disposal, is presented in the FEIS. This alternative would result in very limited unconfined, open-water disposal in Puget Sound due to both the application of the PSIC and the discontinuation of public multiuser disposal sites. The latter would occur because local governments have established shoreline permit conditions for a multiuser site that probably could not be met by most dredgers. These conditions require that comprehensive treatment be given to dredged material disposal including all the objectives addressed by PSDDA. Few dredgers have the necessary resources to accomplish this.

The No Action alternative could result in no dredging for some projects as other disposal options may be cost prohibitive. Social impacts could include lost employment and reduced property values. Some adverse environmental impacts may also occur during the construction of new facilities, even in those areas where marine facilities can be relocated to waters accessible to navigation without dredging.

Environmental Analysis. The disposal sites were selected based on careful consideration of a number of factors, including biological resources, human uses, physical parameters, and haul distances from dredging projects. The selected sites are in locations where significant adverse environmental impacts to the quality of the human environment (per the National Environmental Policy Act (NEPA)) are not anticipated, and human use conflicts have been minimized to the maximum extent practicable.

The environmental impacts associated with alternative biological effects conditions for site management were also examined. The selected site management condition will not result in unacceptable adverse impacts. A full discussion of the environmental impacts associated with the alternatives is contained in the FEIS. An EIS was prepared to "encourage and facilitate public involvement in decisions which affect the quality of the human environment" (40 CFR 1500.2).

Implementation. The Corps and EPA will share, with the State of Washington, responsibility for implementation of the PSDDA management plan for the Phase I area. DNR and Ecology, as well as Pierce County and the cities of Seattle and Everett, will perform the non-Federal functions. DNR will obtain shoreline management permits from the county and the cities for the selected sites for the maximum possible period (currently 5 years). Responsibility will be shared by DNR with the Corps for site management, with DNR generally performing chemical and biological environmental monitoring. Ecology will use the appropriate PSDDA dredged material evaluation procedures as a basis for Section 401 Water Quality certification determinations, and will work in conjunction with Seattle District Corps in developing and operating the dredged material data management system.

The Corps and EPA will use the appropriate aspects of the PSDDA evaluation procedures to guide their respective activities under Section 404. Also, the Corps will be generally responsible for physical monitoring of the disposal sites and developing and maintaining a dredged material data management system for Puget Sound that is intended to meet the needs of all the PSDDA agencies.

Implementation of PSDDA evaluation procedures is expected to begin during the fall of 1988, after the Federal Record of Decision has been completed and the shoreline permits obtained from the local jurisdictions. The selected disposal sites are expected to be available for use by the fall of 1988, after the approval of shoreline permits by local governments (Seattle, Everett, and Pierce County) and Ecology.

Advance identification of the PSDDA disposal sites is being accomplished concurrent with public review of the Phase I draft documents by EPA and the Corps under subpart I of the Section 404(b)(1) Guidelines (40 CFR 230.80). Under this action a determination has been made that the selected Phase I disposal sites are suitable for future disposal of dredged material. The FEIS contains the final determination of suitability.

Review and Revisions. The PSDDA agencies recognize that the state-of-the-art of dredged material testing and test interpretation is rapidly changing. Accordingly, provision is made in the management plan for annual assessments of the data obtained through the regulatory actions on specific dredging projects, as well as the information gained from environmental monitoring of the disposal sites after they have been in use. These assessments will be conducted by the PSDDA agencies with opportunities provided for participation by other interested agencies, organizations, and private citizens. The assessments will provide the basis for appropriate revisions to the PSDDA management plan. Sediment evaluation procedures, site environmental monitoring, and cost aspects of the plan will be reexamined. One result may be a reduction in the level of testing and monitoring, if that is possible without compromising the environmental mandate of the CWA and applicable State authorities.

Study Documents. The primary Phase I PSDDA study documents include this report containing the management plan, three technical appendixes which provide detailed information in support of the plan, and a FEIS focusing on the alternative disposal sites and site management conditions considered for the Phase I area.

o Management Plan Report (MPR) - Unconfined Open-Water Disposal of Dredged Material Phase I (Central Puget Sound). This document describes the study authorities, background, goal, objectives, and planning process which resulted in the PSDDA management plan. The plan is presented with expanded coverage given to major program elements. Also included is a discussion on the implementation of the management plan.

o Disposal Site Selection Technical Appendix (DSSTA). A detailed description of the disposal site selection process is provided along with information on the existing disposal sites and alternative sites considered.

o Evaluation Procedures Technical Appendix (EPTA). This appendix covers the dredged material sampling, testing, and disposal guidelines developed by the PSDDA process.

o Management Plans Technical Appendix (MPTA). Dredging and dredged material disposal permit compliance inspection requirements, environmental monitoring of disposal sites, and other site management activities are dealt with here.

o Final Environmental Impact Statement (NEPA/SEPA) - Unconfined, Open-Water Disposal Sites for Dredged Material, Phase I, (Central Puget Sound). This document presents and evaluates the selected Phase I area unconfined, open-water disposal sites and alternative sites considered. Also presented and evaluated for site management are the selected and alternative biological effects conditions.

PUGET SOUND DREDGED DISPOSAL ANALYSIS
MANAGEMENT PLAN REPORT
UNCONFINED, OPEN-WATER DISPOSAL OF DREDGED MATERIAL
PHASE I (CENTRAL PUGET SOUND)

TABLE OF CONTENTS

TABLE OF CONTENTS (con.)

TABLE OF CONTENTS (con.)

PUGET SOUND DREDGED DISPOSAL ANALYSIS
PROPOSED MANAGEMENT PLAN FOR
UNCONFINED, OPEN-WATER DISPOSAL OF DREDGED MATERIAL
PHASE I (CENTRAL PUGET SOUND)
DRAFT REPORT

CHAPTER 1. AUTHORITIES

1.1 Study Authority. This chapter presents the specific authorities by which the Seattle District, U.S. Army Corps of Engineers (Corps); Region X, Environmental Protection Agency (EPA); Washington Department of Natural Resources (DNR); and the Washington Department of Ecology (Ecology) are participating in the Puget Sound Dredged Disposal Analysis (PSDDA) Study.

1.1.1 Federal Authorities. The Corps has regulatory authority over waters of the United States. This includes dredging and disposal of dredged materials in navigable waters of the United States, such as Puget Sound. The Corps' authority to issue or deny permit applications stems from Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act (CWA) (Public Law 92-500, as amended). Section 404 authorizes the Secretary of the Army, acting through the Corps, to issue permits for the discharge of dredged or fill material into waters of the United States. These permits specify disposal sites for dredged material determined to be suitable for discharge into waters of the United States in accordance with the Section 404(b)(1) Guidelines (discussed below). Section 404(b)(2) of the CWA allows the Corps to issue permits otherwise prohibited by the guidelines, based on consideration of the economics of anchorage and navigation. The public interest review process used by the Corps provides for consideration of a number of factors in permit and project decisions. Permit decisions will be based on an evaluation of probable impacts, including cumulative impacts, of the proposed activity and its intended use on the public interest (33 CFR 320.4). Via this weighing and balancing process, a permit decision is influenced by broad considerations. For activities involving Section 404 discharges, a permit will be denied if the discharge that would be authorized by such a permit would not comply with the Section 404(b)(1) Guidelines (subject to the Section 404(b)(2) exception).

EPA, in conjunction with the Corps, develops guidelines for the implementation and use of disposal sites under Section 404(b) of the CWA. EPA is authorized by Section 404(c) of the CWA, after notice and opportunity for public hearings, to prohibit or restrict the use of a disposal site whenever it determines that the discharge of such materials will have "unacceptable adverse impacts" on municipal water supplies, shellfish beds and fisheries, wildlife, or recreational areas.

The overall guidelines for specification of disposal sites for dredged material are the Section 404(b)(1) Guidelines (40 CFR Part 230), which require consideration of numerous factors prior to allowing disposal of dredged material in waters of the United States. Subpart G of the Section 404(b)(1) Guidelines provides guidance for evaluation and testing of dredged material to

be disposed into waters of the United States. The studies undertaken to develop the PSDDA evaluation procedures were based primarily on the evaluation and testing requirements of the Guidelines (see chapter 5).

The National Environmental Policy Act (NEPA) requires all Federal agencies to assess the environmental impacts of major Federal actions significantly affecting the quality of the human environment and to consider all reasonable alternatives. The Coastal Zone Management Act (CZMA) (Public Law 92-583) requires that Federal projects be consistent to the maximum extent practicable, with the State's coastal zone management program. For non-Federal projects, full consistency is required.

The integration of environmental considerations into the planning process concurrent with the evaluation of economic, social, and technological aspects of a proposal or plan is called for by NEPA. The procedural requirements of these laws specify the documentation and disclosure of this integrated assessment when recommending or proposing an agency action (unless such action is of minor consequence to the environment and is categorically excluded from this assessment). The extent of the documentation is dependent on the degree of potential adverse environmental effects resulting from the proposal. Per NEPA, an environmental impact statement (EIS) is required "in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment" (40 CFR 1502.3). The term "significantly" requires consideration of both "context" (affected region, affected interests, and locality) and "intensity" (degree, controversy, persistence, geographic extent, etc. of effects) (40 CFR 1598.27). EIS's may be needed for specific project proposals, or may be prepared for broad Federal actions (such as the adoption of programs that affect larger geographic areas (i.e., a large water body such as Puget Sound), or that generically involve many similar actions (40 CFR 1502.4)).

NEPA includes "planning to avoid and minimize adverse effects" as one aspect of "mitigation." The PSDDA agencies sought to avoid and minimize any potential adverse effects of the Management Plan for the Phase I area through careful development of plan elements. Consequently, the PSDDA plan elements are, in part, mitigation features of dredged material management in Puget Sound. They are consistent with the goal of environmental protection and the objectives of the CWA. Mitigation that reduces the probable adverse impact to less than significant levels can be a basis for deciding that an EIS is not warranted (as long as the mitigation is an integral part of the original proposal), though NEPA rules discourage this approach.

The decision to prepare an EIS as part of the PSDDA study was not based on an a priori determination that the resulting adverse effects would be "significant." It was recognized that the environmental impacts will depend on where disposal sites are located and the biological effects condition that will be used in disposal site management. Accordingly, the agencies participating in the PSDDA study agreed to prepare an EIS to "encourage and facilitate public involvement in decisions which affect the quality of the human environment" (40 CFR 1500.2). The PSDDA plan of study notes that the EIS will provide "the basis for subsequent implementation actions" by the PSDDA agencies (see chapter 9).

The Section 404 Guidelines also allow advance identification of areas suitable (or not suitable) for discharge of dredged material (40 CFR 230.80). Exhibit B of the FEIS contains a Public Notice: "Final Determination of Suitability for Disposal of Dredged Material in waters of Central Puget Sound," issued under this authority by the Corps and EPA.

1.1.2 State Authorities. The State of Washington's authorities related to dredged material disposal are both regulatory and proprietary. The State's regulatory authority stems from the CWA and CZMA, and from the State Water Pollution Control Act and Shoreline Management Act (SMA).

Congress granted to the States the responsibility for certifying under Section 401 of the CWA that a proposed discharge, resulting from a project described in a Corps public notice issued under Section 404 of the CWA, will comply with the applicable provisions of State and Federal water quality laws. This certification is required for Federal activities, and from any applicant for a Federal permit to conduct any activity, which may result in any discharge into State waters. Compliance with Section 401 also ensures that any such discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA and relevant State laws.

In particular, Section 303 of the CWA provides for establishment of State water quality standards. The existing State of Washington standards reflect the State's policy to maintain the highest possible standards to ensure the purity of all waters of the State. This public policy, as enunciated in the State's Water Pollution Control Act (90.48 RCW), was established to protect public health and public enjoyment of the State's water. The standards recognize the need to protect the purity of water for wildlife, birds, game, fish and other aquatic life and for the industrial development of the State. To these ends the State requires the use of all known available and reasonable methods by industry and others to prevent and control the pollution of the waters of the State of Washington. Consistent with this policy the State of Washington exercises its powers, as fully and as effectively as possible, to retain and secure high quality for all waters of the State.

The State of Washington's Water Pollution Control Act designated the Department of Ecology as the agency for carrying out all State responsibilities of the CWA as amended. Pursuant to Section 303 of the CWA, Ecology has established water quality standards for the State (WAC 773-201). Among other requirements, the standards do not allow the discharge of toxic or deleterious material which may affect the natural aquatic environment.

Ecology establishes guidelines for State and local administration of the SMA (RCW 90.58). Ecology ensures that permits issued by local governments are consistent with the intent of the act. Issuance of a shoreline permit also enables Ecology to certify a project's consistency with the CZMA.

The State's aquatic land proprietary authority is administered by DNR (RCW 43.30 and Title 79). DNR manages tidelands and bedlands of Puget Sound,

including the disposal sites. Regulations for designating State-owned aquatic land sites for open-water disposal and proprietary use fees have been established in WAC 332-30-166.

DNR designates acceptable disposal sites, secures a local shoreline permit (also providing CZMA consistency) for use of each site, issues individual use authorization to each disposal site user (other than the Corps), and manages site use. Site designation has been historically accomplished by an interagency siting committee established and chaired by DNR. The Corps participates on this committee and has generally utilized the State-designated sites for Federal dredging projects. Corps approval of disposal site use depends on a finding of compliance with the CWA Section 404(b)(1) Guidelines.

The State Environmental Policy Act (SEPA RCW 43.21c) requires consideration of environmental impacts of taking "actions" as defined by the regulations. Policies set forth in SEPA provide for a systematic, interdisciplinary approach to decisionmaking which might impact the environment. In addition, evaluations should ensure that environmental values will be given appropriate consideration along with economic and technical considerations. The PSDDA Management Plan is subject to SEPA.

1.2 Corps of Engineers 404(b)(1) Procedures and Policies.

1.2.1 Overview. Navigable waterways of the United States have and will continue to play a vital role in the Nation's development. The Corps, in fulfilling its mission to maintain, improve, and extend these waterways, is responsible for the dredging and disposal of large volumes of sediment each year. Nationwide, the Corps dredges about 230 million cubic yards (c.y.) in maintenance and about 70 million c.y. in new dredging operations annually at a cost of about $450 million. In addition, 100-150 million c.y. of sediments dredged by others each year are subject to permits issued by the Corps. In accomplishing its national dredging and regulatory mission, the Corps has conducted extensive research and development in the field of dredged material management. Regulations, policies and technical guidance prepared and used by the Corps are based on operating experience and results from extensive research programs. Federal expenditures on dredged material research have cumulatively exceeded $100 million. Corps policy is evolving as dredged material research provides a better understanding of the environmental impacts that can be anticipated from dredging and dredged material disposal. Existing Corps national policy is reflected in the final rule for Corps operation and maintenance dredging of Federal navigation projects published April 26, 1988 (33 CFR Parts 209, 335, 336, 337, and 338) and in the final rule for the Corps' regulatory program published January 12, 1987 (33 CFR Parts 320-330).

The following discussion summarizes standard Corps policies with regard to the disposal of dredged material. These policies provide for the least costly alternative, consistent with sound engineering practices and appropriate environmental quality standards (see Management Plans Technical Appendix (MPTA) for a more complete presentation of this policy). The details of the dredged material testing and test interpretation guidelines are included in an exhibit to the Evaluation Procedures Technical Appendix (EPTA).

1.2.2 Corps Authorities and Responsibilities. The Corps has regulatory responsibility for all dredged material disposal activities that occur within waters of the United States. The Corps responsibility involves review of some 10,000-30,000 permit applications each year as well as appropriate maintenance of, and improvements to, the 25,000 mile congressionally-authorized Federal navigation system serving 42 of the 50 states.

Section 404 of the CWA requires the Corps to evaluate the proposed discharge of dredged material into waters of the United States in accordance with the Section 404(b)(1) Guidelines. Requirements of other Federal laws may also apply.

1.2.3 Section 404(b)(1) Compliance. The Section 404(b)(1) Guidelines require compliance with several conditions prior to allowing disposal of dredged material in waters of the United States. Compliance requires the avoidance of "unacceptable adverse effects" to the aquatic environment. The Guidelines specify the following four conditions of compliance ("restrictions on discharge" per 40 CFR 230.10):

1. There is no other practicable alternative that would have less adverse impact on the aquatic environment.

2. The disposal will not result in violations of applicable water quality standards after consideration of dispersion and dilution (40 CFR 230.10(b)(1)), toxic effluent standards, or marine sanctuary requirements, nor will it jeopardize the continued existence of threatened or endangered species.

3. The disposal will not cause or contribute to significant degradation of the waters of the United States.

4. All appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic environment.

The findings of compliance with condition No. 3 are to be based, in part, on "evaluation and testing" of the proposed dredged material disposal on the aquatic environment (40 CFR 230.11). Per the Guidelines (40 CFR 230.61), specific evaluation procedures, including chemical and biological tests to determine compliance with the Guidelines and State water quality standards, are used by the Corps.

The Corps' final decision on any proposed dredged material disposal activity, however, must be based on a broad public interest review which not only considers information derived from chemical and biological tests, but which also considers an evaluation of the probable impact, including cumulative impacts of the proposed activity, on the public interest. In addition, embodied within this public interest review, is a Corps requirement to ensure that the substantive concerns of over 30 Federal environmental laws, Executive Orders (EO's), etc., are properly addressed, whenever applicable. These include the CZMA, the Marine Protection, Research, and Sanctuaries Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, EO 11990

(Protection of Wetlands) and EO 11988 (Floodplain Management). While each of these Federal Statutes (including the CWA) is generally "resource specific" in regard to environmental protection, the Corps public interest review necessitates full consideration of all relevant information before rendering a decision. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposed activity will be considered.

The Corps' final decision will reflect the national concern for both protection and utilization of important resources. As such, the Corps is neither a proponent or opponent of dredging projects, but considers the merits of each on a case-by-case basis.

1.2.4 Corps Policy. The Corps, as agency policy, utilizes a standard philosophy and process in evaluating proposed dredged material disposal activities relative to the general public interest. This process is intended to meet environmental requirements at the least cost, within a consistent national framework. The standard provides a reference point for Corps field offices in addressing regional issues of dredged material management. Its intent is to ensure a necessary level of national consistency in the manner in which individual proposals for dredged material disposal are evaluated (e.g., testing procedures) and undertaken, while also ensuring a necessary level of flexibility by the Corps field offices to account for region-specific considerations. Significant deviations from national testing and evaluation guidance require consideration of cost, utility of information and full technical explanation and documentation in the Section 404(b)(1) evaluation.

For Corps operation and maintenance projects, it is the Corps responsibility, in developing dredged material disposal alternatives, to consider all facets of the dredging and disposal operation, including technically appropriate test and evaluation procedures, cost, engineering feasibility, overall environmental protection, and the "no dredging" option. The alternative selected by the Corps should be the least costly alternative, consistent with sound engineering and scientific practices, and meeting applicable Federal environmental statutes. This is viewed as the Corps' "Federal standard" (51 Fed. Reg. 19694).

The following paragraphs summarize the manner in which the Corps implements its national policies in evaluating permit proposals and Federal projects.

a. Permit Activities. The applicant for a Section 404 permit will receive guidance from the Corps as the permitting authority (40 CFR 230.61) concerning appropriate tests and evaluation procedures that will be applied to material proposed for dredging. This guidance will be in compliance with the Section 404(b)(1) Guidelines.

b. Corps Projects. For Corps projects, the Corps is required to use the Section 404(b)(1) Guidelines to determine the appropriate test and evaluation procedures for delineating the least costly, environmentally acceptable disposal alternative as well as to demonstrate compliance with applicable State water quality standards.

The Corps submits its findings concerning project compliance with the 404 Guidelines and State water quality standards to the State via the Public Notice process along with a request for Water Quality Certification. The certification request also includes relevant information to demonstrate compliance with applicable State water quality standards.

The Corps Public Notice and Finding of Compliance or Non-Compliance with the Section 404(b)(1) Guidelines, serves as a point of reference in any subsequent coordination with the State concerning additional requirements or conditions which the State may require for Water Quality Certification. The Corps' District Engineer has the necessary discretionary authority to develop additional evaluative information requested by the State. The legislative record for the CWA provides congressional recognition that Federal project costs may be increased in some instances to mitigate reasonable and technically appropriate State water quality concerns. However, if the District Engineer determines that a State's requirements are inappropriate, he may request that the State or project sponsor fund the additional costs associated with any such requirement. In such cases where the State or project sponsor agrees to fund the additional costs, the District Engineer must also determine and appropriately notify the State and project sponsor that such additional costs may affect the continued economic viability of the Corps project in question. In the event that the State or project sponsor does not agree to fund the additional cost, the District Engineer may defer dredging while determining if the dredging project is economically justified and is in the public interest.

This guidance serves as a consistent national framework and reference point for Corps field offices which must also address regional issues in dredged material management. In applying the process to different projects or regions of the country, it is necessary to detail specific testing procedures and adopt interpretation guidelines, as appropriate. Corps field office evaluations must be generally consistent with the national procedures, defensible in light of research results and scientific judgment, cost and time effective, and of direct use in Section 404 decisionmaking.

1.3 State of Washington Procedures and Policies on Dredging and Dredged Material Disposal.

1.3.1 Overview. In Washington, dredged material disposal is addressed by several programs at the State and local levels. These include State 401 Water Quality Certification, State water quality and dangerous waste laws, the State SMA and local shoreline management plans, State Hydraulics Project Approval, State proprietary management of State-owned aquatic lands, and by the Puget Sound Water Quality Managment Plan. The PSDDA plan treats these programs as a unified body of State policy.

1.3.2 Guidelines and Policies. The policies which cover the discharge of dredged material are the same as those for the discharge of any material into State waters. These policies are specified in the State of Washington Water Pollution Control Law RCW 90.48.020 and the Water Resources Act of 1971, RCW 90.54.020.

RCW 90.54.020 (3) reads, in part, "The quality of the natural environmental shall be protected and, where possible, enhanced as follows:

(b) Waters of the state shall be of high quality. Regardless of the quality of the waters of the state, all wastes and other materials and substances proposed for entry into said waters shall be provided with all known, available, and reasonable methods of treatment prior to entry. Notwithstanding that standards of quality established for the waters of the state would not be violated, wastes and other materials and substances shall not be allowed to enter such waters which will reduce the existing quality thereof, except in those situations where it is clear that overriding considerations of the public interest will be served."

Current guidance and policies with regard to the evaluation of sediments to be dredged are embodied in the documents described below.

a. Guidelines for Issuing Water Quality Certifications for Dredging and Discharge of Dredged Material Department of Ecology, 82-13. This document describes minimum evaluation and testing procedures and guidance for overall project review.

b. Puget Sound Interim Sediment Criteria (PSISC) for Dredge Material, August 1985. The interim criteria was specifically developed for application in Puget Sound. The criteria established minimum chemical and biological sampling and analysis requirements. The criteria also established a numerical standard by which to make determinations on the suitability of dredged sediments for disposal in the unconfined, open-water disposal sites.

c. Protocol for the Use of Priority Pollutant Data to Determine Compliance with the Dangerous Waste Regulation. This protocol provides methodologies for evaluating data from chemical analysis of marine sediments to determine if additional testing under dangerous waste regulations is required. It is reserved to the professional judgment of the project reviewer to determine if the data indicates the guidelines should be applied to dredged sediments. However, it is the policy of the State that, if so warranted by the appropriate tests, marine sediments including dredged material can be classified as a dangerous or hazardous waste.

d. SMA Guidelines, WAC 173-16-060 (16) "Dredging." Local governments are to control dredging to minimize damage to existing ecological values and natural resources of both the area to be dredged and the area for deposit of dredged material. Identification of in-water disposal sites are to be identified cooperatively by local and State agencies. Local governments have adopted individual shoreline management plans and ordinances in support of this policy. A model local shoreline management element has been proposed through PSDDA to provide consistency in how communities treat dredged material disposal.

e. Proprietary Regulation of Open-Water Disposal (WAC 332-30-166). This regulation establishes State policy on disposal site selection, proprietary use authorization, and use of disposal sites. These regulations are administered by DNR and will be updated to support the PSDDA management plan.

f. Puget Sound Water Quality Management Plan. In 1985 the State legislature established a Puget Sound Water Quality Authority (90.70 RCW) to develop, adopt, and oversee implementation of a Puget Sound Water Quality Plan. The plan has several objectives including:

(1) Long and short term goals and objectives for water quality management in the Sound.

(2) An analysis of laws, regulations, programs, and policies affecting water quality with recommendations for improving these.

(3) Better coordination of Federal, State, and local efforts affecting water quality.

According to statute, the plan is to address a broad range of pollution management issues which includes dredged material disposal. The final plan was adopted in December 1986 and implementation began in January 1987. For marine sediments the Authority directed Ecology to establish a classification system for sediments that cause observable adverse biological effects and to develop programs for management of dredging and dredged disposal.

Implementation of the PSDDA management plan and designation of unconfined dredged material disposal sites are part of meeting the specific requirements of the legislation requiring adoption of the plan (90.40 RCW).

1.4 Integration of Federal and State Roles. Section 404 of the CWA provides for specification of disposal sites and an evaluation of the material to be discharged at a specific disposal site. The manner in which the Federal guidelines are implemented is described in section 1.2 above.

The CWA also provides in Section 401 an opportunity for the State to evaluate discharges into State waters which are being permitted by a Federal agency. The primary method of evaluation is through an appropriate demonstration that the discharge will meet State Water Quality Standards. This State responsibility takes into account effects on the water body and toxic and deleterious effects on aquatic biota. For discharges of dredged material, the State has taken the approach of evaluating dredged material to prevent the reintroduction of chemicals at levels which show indications of unacceptable adverse biological effects. Disposal sites in Puget Sound are selected through the procedures by prescribed by DNR to avoid or minimize effects on important environmental resources.

The roles of State and Federal regulatory agencies in management of dredged material overlap in certain respects. For this reason, PSDDA agencies sought to develop a single dredged material evaluation and disposal site identification program which is consistent with both State and Federal requirements. However, there can be, and are, some differences in State objectives and Federal objectives for dredged material management regarding test procedures and data interpretation in determining the acceptability of dredged material for unconfined, open-water disposal. For example, State water quality objectives

under State law can be different than under Federal law, and the Puget Sound Water Quality Plan contains specific sediment quality objectives for Puget Sound. Testing requirements need to be responsive to both Federal and State laws and objectives.

The PSDDA plan, while recognizing differences between State and Federal objectives, nevertheless seeks to maximize use of procedures and decision tools which meet objectives of both. The result is disposal site locations which are acceptable under both State and Federal authorities and dredged material evaluation procedures which have only minor technical differences between the State 401 and the Federal 404 approaches. These minor differences allow incorporation of testing needed to evaluate sediment toxicity questions while maintaining the integrity of Federal evaluation procedures to address ecologi- cal effects on a project specific basis.

CHAPTER 2. BACKGROUND

2.1 Introduction. This chapter provides background to PSDDA including a description of the study area, issues and concerns which led to the study and study scope limitations. The relationship to other ongoing Puget Sound water quality planning efforts and Indian Fishing Treaty rights is reviewed. Finally, the study documents are identified and briefly described.

2.2 Study Area Description.

2.2.1 Geographic Divisions. As shown in figure 2.1, Puget Sound is one of three general bodies of water comprising the broader Puget Sound Region. Roughly separated from each other by shallow submerged ridges called sills, the three divisions consist of the Strait of Juan de Fuca, the Strait of Georgia, and Puget Sound proper, extending south from Admiralty Inlet near Port Townsend to Budd Inlet at Olympia.

The Puget Sound division can be further segmented into four basins: The central basin which lies between Admiralty Inlet and the Tacoma Narrows; the Whidbey basin between Whidbey Island and the eastern mainland; Hood Canal; and the southern basin which extends south of the Tacoma Narrows.

2.2.2 Phase I Area. This report and the accompanying final environmental impact statement (FEIS) present the study findings for the Phase I area of PSDDA as shown in figure 2.1. This area encompasses central Puget Sound, which includes the major urban embayments of Seattle, Tacoma, and Everett. The Phase II area (balance of the Puget Sound Region) will be the subject of a separate report and EIS.

2.2.3 Physical Features. The Puget Sound Region was formed by global tectonic processes, giving rise to such major features as the Cascade and Olympic Mountains ranges which flank the basin to the east and west, respectively. However, the shape of the inland sea that now floods portions of this region is largely the result of more localized and relatively recent glaciation. Repeatedly during the last ice age, ice pushed southward from British Columbia through the Strait of Georgia and over the Puget Sound Region, the last such advance occurring about 10,000 years ago.

Puget Sound is an estuary where seawater from the Pacific Ocean mixes with freshwater from a large number of rivers. In some areas of the region, annual precipitation approaches 100 inches. The average annual flow of freshwater to the Sound is about 45,000 cubic feet per second.

The Whidbey basin accounts for most of the total freshwater discharged into Puget Sound. Over 60 percent of the Whidbey basin freshwater discharge is from the basin's largest rivers: the Skagit, Snohomish, and Stillaguamish Rivers. The main subbasin accounts for less than 20 percent of the total freshwater input to Puget Sound. The largest source for this basin is the Puyallup River, but significant flows are also received from the Green and

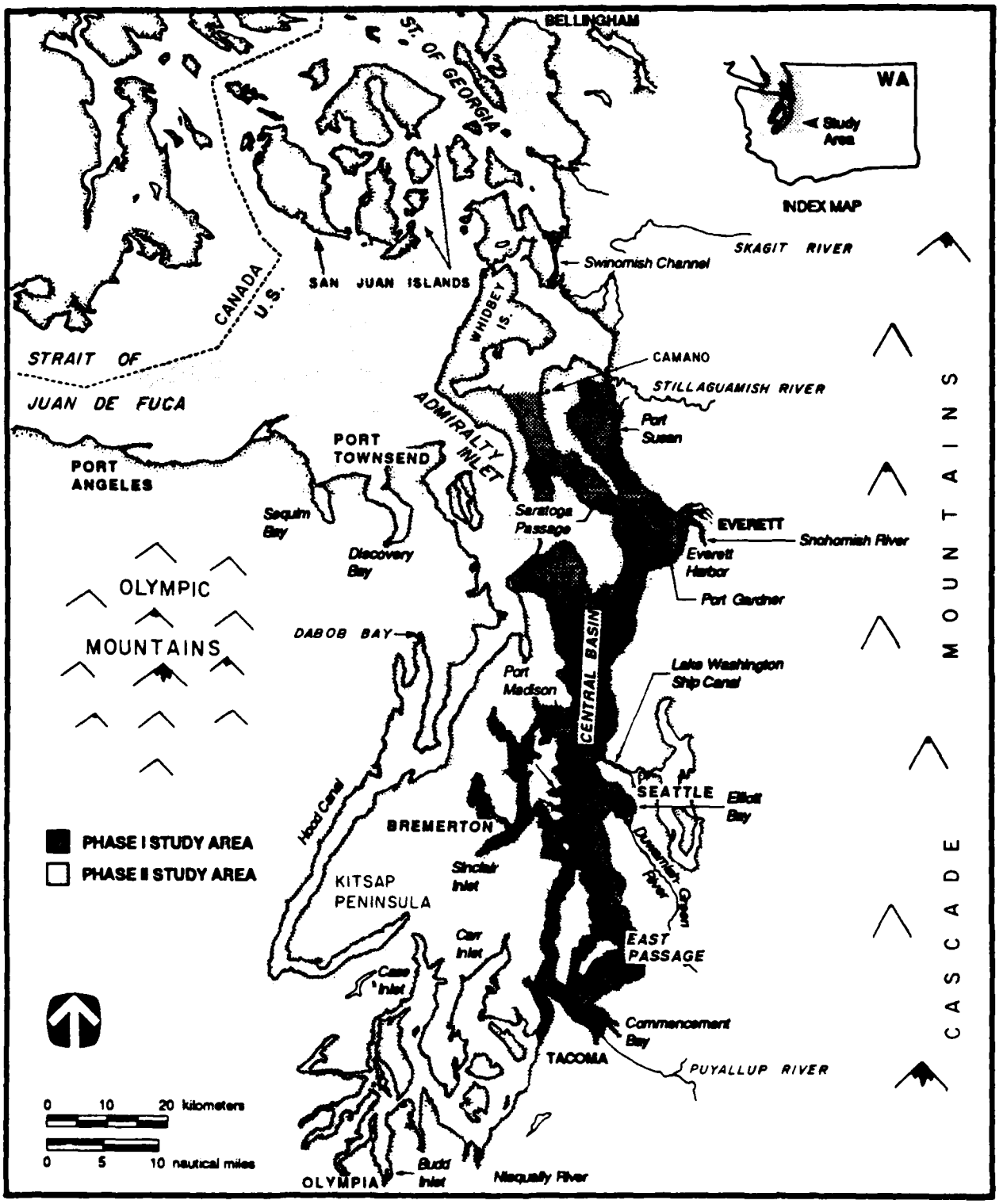


Figure 2.1 Study area -
Puget Sound Dredged Disposal Analysis

Duwamish Rivers. The principal river entering the southern basin is the Nisqually, contributing a little more than 10 percent of Puget Sound's freshwater input. Another 10 percent enters Puget Sound via Hood Canal through rivers draining the east slope of the Olympic Mountains and from small streams on the Kitsap Peninsula. Annually about 18 million c.y. of sediments are released into Puget Sound by the rivers and streams.

The unique diversity of Puget Sound waters, from deep, open water to saltwater and freshwater marshes, creates numerous productive habitats that support rich populations of shellfish, finfish, marine mammals, birds, and wildlife.

2.2.4 Social and Economic Features. The physical nature of the Puget Sound Region makes the region well suited for the harvest of natural resources and for water-dependent commerce and industry. The region's beauty and diversity attract recreation, too. Well over half of Washington's population lives in the Puget Sound Region, and about 2.2 million reside in the metropolitan corridor of Tacoma, Seattle, and Everett.

While harvesting natural resources has been and continues to be a major segment of the area's economy, service and high technology industries have grown in importance. Waterborne commerce and water-related industry also remain important factors in the economic well-being of the Puget Sound Region. According to the Puget Sound Water Quality Authority's (PSWQA) State of the Sound report, marine shipping alone may support as many as 100,000 jobs at this time.

In the 30 years between 1953 and 1983, total annual tonnage of maritime shipping on Puget Sound more than doubled, to over 50 million tons. Most of this increase can be attributed to an expansion of international trade, representing a doubling of total tonnage since 1968. The PSWQA, in its 1986 State of the Sound report, cites a forecast that suggests foreign cargo movements could increase from 26 million tons in 1983 to at least 40 million tons by the year 2000. In addition to shipping, more than 200 small boat harbors in the area meet the needs of commercial fishing vessels and pleasure craft.

2.3 Dredging and Dredged Material Disposal. Dredging is necessary to maintain waterways and harbors used for shipping and boat traffic, as well as for new port and marina construction. In addition to navigation improvement projects carried out by the Corps, dredging and dredged material disposal is also undertaken by Puget Sound ports, maritime industries, other Federal and State agencies, municipalities, and private companies. New and continued need for dredging and the disposal of dredged materials is evident from Federal and State permit applications received monthly for such projects in navigable waters.

Since initial development of the cities and industries in Puget Sound, the volume and extent of dredging has grown proportionally with the development of waterborne commerce and recreational boating. Dredging and disposal of dredged material has been a common and longstanding practice, producing large

volumes of dredged material each year. This includes new port and harbor construction and maintenance dredging. The latter ensures continued safe water depths for existing shipping channels and dock areas. Historically, most of the dredged material was deposited on uplands or in nearshore tidal areas as fill for harbor developments. As areas near the dredging activity have been filled or are not available due to land use conflicts, a greater portion of dredged material is being discharged into the Sound. Public policy, as reflected in recent regulatory decisions, has been to increasingly protect environmentally important tidal areas, wetlands, and marshes.

The Duwamish Waterway Project, in Seattle, is an example of the difficulty in securing acceptable upland disposal sites. One of the Corps' largest ongoing channel maintenance dredging projects, the Duwamish Waterway, changed from upland to open-water disposal in the 1970's. Open space in the urban and industrial environment of this waterway has, in the last 20 years, diminished to the point where nearby upland disposal sites are now largely nonexistent.

The lack of acceptable upland disposal sites in most urbanized areas is viewed by the ports and the regulatory agencies as a significant concern, which is being addressed by a separate follow-on study to PSDDA. That study is dealing with the need for public multiuser confined disposal sites (see paragraph 2.6.4).

As shown in table 2.1, of the 16.8 million c.y. dredged between 1970 and 1985 from the Phase I area, approximately 36 percent was discharged to the three existing DNR-operated unconfined, open-water disposal sites located in Commencement Bay, Elliott Bay, and Port Gardner. These are public multiuser disposal sites requiring a DNR permit for their use. The balance of the dredged material was primarily used as a convenient source of fill for harbor development. Since implementation of the stringent Puget Sound Interim Criteria (PSIC), a significant percentage of material considered for unconfined, open-water disposal, has been rejected for this disposal option. For the affected projects, dredgers have been forced to find their own confined disposal site or not proceed with the dredging project.

Volumes dredged by the Corps, the ports, and others each represent about one-third of the total during this period. Of this material, the ports placed about 70 percent of their dredged material in upland and nearshore sites, while the Corps and other dredgers placed only 62 percent and 50 percent, respectively, in upland and nearshore areas. These figures suggest that dredgers other than the Corps and ports have relied more heavily on unconfined, open-water disposal, perhaps due to fewer opportunities for land development projects. The Fourmile Rock disposal site in Elliott Bay was the most heavily used site, receiving approximately 76 percent of the total dredged material discharged at the DNR designated Phase I area disposal sites.

As upland and nearshore disposal sites have become scarce, reliance on unconfined, open-water sites has increased. While only 26 percent of the Corps dredged material went to open-water sites in the 1970's, about 56 percent has been going to open water in the 1980's. Permit applications also point toward a continued or increasing demand for open-water disposal sites.

TABLE 2.1

PUGET SOUND DREDGED MATERIAL INVENTORY
PHASE I AREA (SEATTLE, TACOMA, EVERETT)
1970-1985

Total Volume Dredged	16,850,000 c.y.
Total Volume Disposed to Unconfined, Open Water	6,758,000 c.y.
Total Volume Disposed at:	
Port Gardner (Everett) Site	692,000 c.y.
Elliott Bay (Seattle) Site	4,598,000 c.y.
Commencement Bay (Tacoma) Site	782,000 c.y.
Other Locations 1/	686,000 c.y.

	Corps Projects	Port Projects	Other Projects
Total Volume Dredged (c.y.)	5,755,000	4,635,000	6,460,000
Total Volume Disposed to Unconfined, Open Water (c.y.)	2,167,000	1,389,000	3,202,000
Total Volume Disposed Upland or Nearshore (c.y.)	3,588,000	3,246,000	3,258,000

	Disposal Methods for Corps of Engineers Projects 1970-1980		1980-1985	
	Volume	Percent	Volume	Percent
Unconfined, Open Water	961,000	26	1,206,000	56
Upland/Nearshore	2,661,000	74	927,000	44

1/Not all dredged material was discharged at designated DNR sites.

A 15-year planning horizon was used, as it encompasses all known major navigation projects and is a forecasting period that could be established with reasonable certainty. The projected total volume to be dredged between 1985 and 2000 is 22,697,000 c.y., or about 35 percent more than the total dredged during the previous 15 years (see table 2-2). Most of the projected dredging could occur in five areas: the Duwamish River, the Snohomish River, Port Gardner's East Waterway, the Blair Waterway in Commencement Bay, and Lake Washington. Much of this dredging will be channel maintenance by the Corps. In the recent past maintenance projects have used unconfined, open-water disposal sites. Approximately 3.3 million c.y. for Port Gardner and vicinity is associated with the Navy Homeport project. This project has been included to present a total future dredging volume for comparison with historical dredging statistics. As a decision has been made not to use the Port Gardner PSDDA disposal site for dredged material resulting from the Navy project, its volume has been excluded from impact analysis associated with future discharges at the PSDDA Port Gardner disposal site.

The costs of maintaining and constructing navigable waterways in Puget Sound waters has changed over the past several years, with costs rising over time. Increased costs are due to a variety of factors, but two of the more important in Puget Sound are the rise in costs for dredging and disposal of dredged material and costs for environmental evaluation of the material. An analysis presented in chapter 5 of this report and section 5 of the FEIS reveals how environmental testing costs and project costs have changed since 1974 in the Puget Sound region. The trend of average testing costs from 1974 to 1987 is illustrated in figure 2.2 for selected projects using the Elliott Bay Fourmile Rock disposal site for some or all of dredged material disposal. The costs presented here were not adjusted for inflation (e.g., normalized to a base year), but are reported as actual costs for the year in which they were incurred. Testing costs between 1974 and 1984 were very low, averaging less than $0.01 per c.y. of material dredged. Part of the reason for the low testing costs was the fact that while dredged material was an environmental issue in Puget Sound, the only problem area of concern was potential water column effects. Most of the testing undertaken was to assess the availability of chemicals of concern to the water column. However, the main reason for the low project-specific costs is that several large dredging studies were conducted during this time period in Grays Harbor, Commencement Bay, and elsewhere in the Nation which addressed many of the specific questions about dredging and water column effects. Findings from these studies were applied to all projects in the region, and reduced the need for project-specific testing and testing costs.

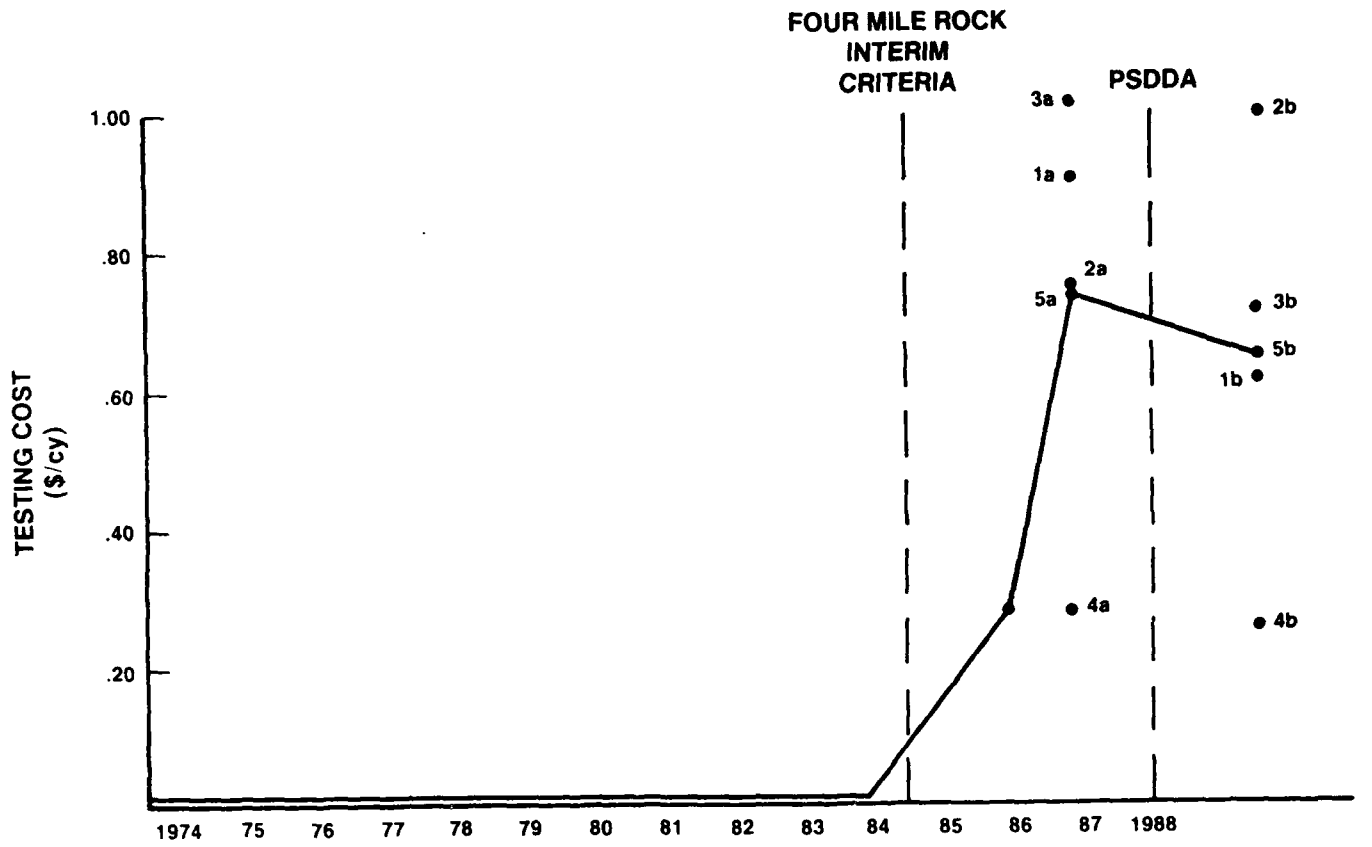
Following adoption of the Fourmile Rock Interim Criteria in 1984, project-specific environmental testing costs rose sharply, as shown in figure 2.2. By the time the Fourmile Rock criteria were developed, the focus of sediment evaluation had shifted from water column effects to potential effects related to the dredged material itself; particularly from chemicals that might be associated with the material to be disposed. The Fourmile Rock criteria required an intensive sampling scheme (one core for every 4,000 c.y.), and

TABLE 2.2

PHASE I AREA
15-YEAR PROJECTIONS (1985-2000) OF TOTAL DREDGING VOLUMES

	Dredging Area (Subarea)	Projected Volume (Cubic Yards)
Port Gardner and vicinity	East Waterway	3,552,000 1/
	Lower Snohomish	2,321,000
	Upper Snohomish	2,175,000
	All Other Areas	195,000
	Subtotal	8,243,000
Elliott Bay and vicinity	Lower Duwamish	4,812,000 2/
	Upper Duwamish	2,021,000
	Duwamish Turning Basin	612,000
	Lakes: Kenmore/Sam. R.	114,000
	Lakes: Lake Washington	1,368,000
	Lakes: Lake Union	5,000
	Lakes: Lake Wash. Canal	80,000
	Sinclair Inlet	200,000
	Eagle Harbor	115,000
	All Other Areas	1,198,000
	Subtotal	10,525,000
Commencement Bay and vicinity	Hylebos Waterway	216,000
	Blair Waterway	2,936,000 3/
	Sitcum Waterway	56,000
	Other Waterways	166,000
	All Other Areas	555,000
	Subtotal	3,929,000
	TOTAL 1/, 2/, 3/	22,697,000

1/Includes U.S. Navy Homeport project (3,300,000 c.y.).
2/Includes Duwamish widening and deepening project (2,550,000 c.y.).
3/Includes Blair/Sitcum navigation improvement project (2,500,000 c.y.).



a: Actual testing costs b: Testing costs under PSDDA;

1a,b: Kenmore Navigation O&M.

2a,b: Seattle Harbor O&M West Waterway.

3a,b: Port of Seattle, Terminal 30.

4a,b: Seattle Harbor O&M Upper Turning Basin.

5a,b: Average costs based on total testing costs/total cy for all four case studies.

Figure 2.2. Historical trend — dredged material testing costs.

both chemical and biological testing. Material from two Seattle Harbor maintenance dredging projects were tested under the Fourmile Rock criteria. Environmental testing for these two projects resulted in costs of $0.28 per c.y. (upper turning basin) in 1986 and $0.75 per c.y. (West Waterway) in 1987 (figure 2.2).

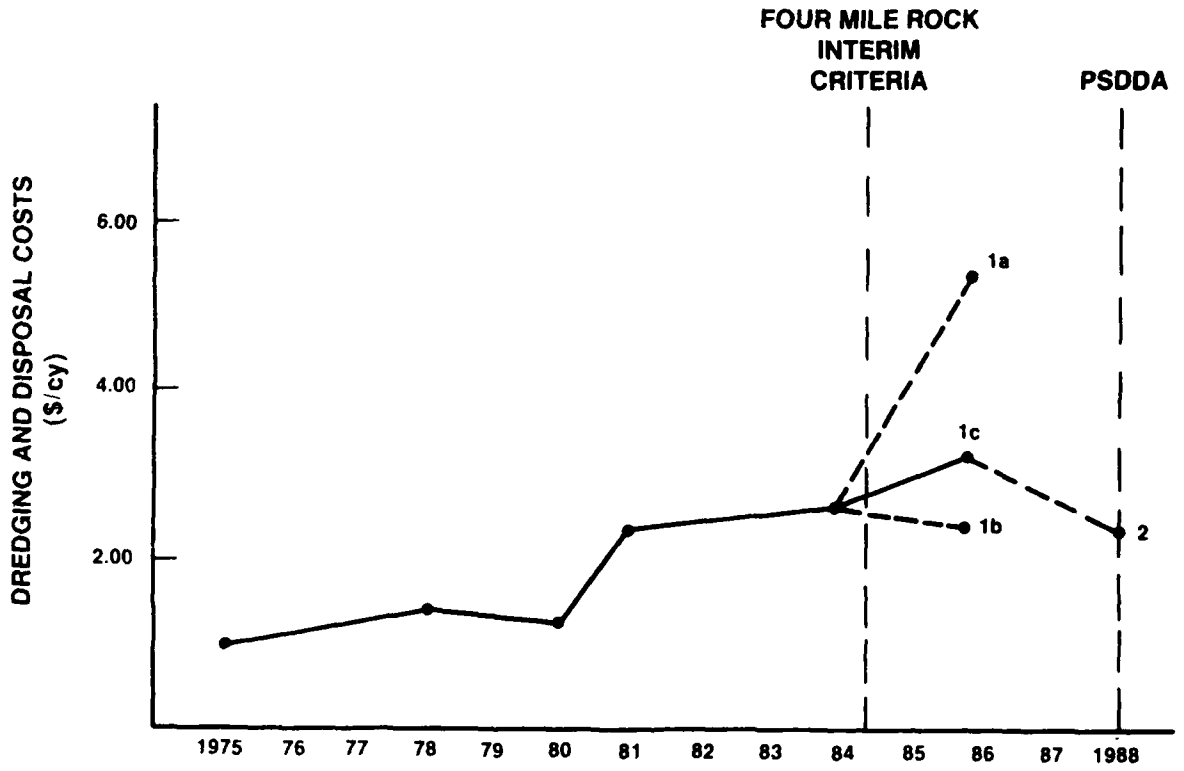
Although no projects have been conducted using PSDDA dredged material evaluation procedures, several case studies were considered in order to estimate the costs of conducting testing under PSDDA (for details, see chapter 5). The projects selected were all from the Seattle area and included three projects from the Duwamish River. The case studies indicate that PSDDA could result in a change in testing costs relative to costs associated with testing under the Fourmile Rock criteria. Testing costs under PSDDA were estimated from the case studies to range from a high of $1.00 per c.y. to a low of $0.26 per c.y. When compared with actual costs for the case study projects, PSDDA testing costs ranged from an increase up to 34 percent or a decrease by as much as 32 percent, depending on project-specific attributes.

As with testing, cost data on dredging and disposal from the Seattle Harbor (Duwamish River) maintenance project were used to determine trends in these costs for the Puget Sound region. Costs associated with dredging and disposal are illustrated in figure 2.3. Average dredging and disposal costs have generally risen since 1975, going from about $1.00 per c.y. dredged to over $3.00/c.y. This increase in costs reflects a number of factors, including inflation, a large increase for equipment, manpower, and fuel costs, and lack of available disposal sites. The trend under PSDDA should be to lower dredging and disposal costs over those experienced from use of the interim criteria (Fourmile Rock, Port Gardner, PSIC). This is because more material is expected to be found suitable for unconfined, open-water disposal. However, the costs under PSDDA will exceed those experienced prior to the interim criteria.

2.4 Issues/Concerns Leading to Study.

2.4.1 Water Quality Issues. The perception of Puget Sound as a relatively pristine water body has undergone reconsideration in the years since 1978. The historic practice of discharging untreated or only partially treated industrial and municipal effluent into Puget Sound, combined with input of chemicals from a variety of other point and nonpoint sources, resulted in the degradation, over time, of the water and sediment quality in portions of Puget Sound. Increasing scientific evidence about the harmful effects of pollution on the estuary has served to heighten public and agency concern about the long term environmental health of the estuary and the impact that various activities can have on the Sound's ecosystem. Research conducted by NOAA indicates that tumors and other biological abnormalities found in some fish and shellfish, especially in the urban/industrial areas near Tacoma, Seattle, and Everett, may be linked to the chemicals in harbor sediments.

Recent and ongoing efforts to improve regulatory control of chemicals at their source have resulted in general improvements in water quality. Concerns remain, however, that because chemicals tend to bind to the particles and settle to the bottom, the sediments in certain portions of the Sound may persistently contain high levels of potentially harmful chemicals. Data



1a,b,c Dredging and disposal costs for one project (actual). 1a: Material costing $5.68/cy represents costs of confined nearshore disposal.
1b Represents costs for material that went to unconfined open-water. 1c: Represents average cost/cy for the project.

2 Average cost of dredging and disposal for project shown under 1a,b,c, but evaluated under PSDDA guidelines. All material estimated to be acceptable for open-water disposal

Figure 2.3. Historical trend — dredging and disposal costs — Seattle Harbor (Duwamish River).

indicate that chemicals that have entered the major harbor areas near population and industrial centers, have accumulated over time in a variety of shoreline areas including navigation channels and vessel berthing locations. Furthermore, oceanographers estimate that 60 to 80 percent of the water flowing out of the central and south Sound on outgoing tides is recycled back into the system. Most chemicals released into the Sound appear to never leave and generally accumulate in the bottom sediments.

The fact that chemicals are often found in the bottom sediments of shipping waterways has raised concerns about disposal of dredged materials removed from waterways. These concerns have prompted agencies and the public to reassess dredged material disposal, which can involve the relocation of sediment-bound chemicals from a navigation channel to the disposal site.

Because information on Puget Sound disposal sites was inadequate and impacts not well documented, public pressure was exerted in 1984 and 1985 to severely restrict or to prohibit dredged material disposal in Puget Sound. Through the State of Washington SMA, several local governments imposed stringent conditions on renewal of shoreline development permits governing unconfined, open-water disposal at public multiuser sites located within their jurisdictions. These permits are obtained by DNR, which in turn make DNR and Ecology accountable for ensuring that dredged material does not cause unacceptable adverse effects.

PSDDA study is focused on unconfined, open-water disposal of dredged material, an activity that must consider the potential presence and effects of sediments containing chemicals of concern. To place this activity in some perspective, periodic dredging by the Corps of Engineers of Federal navigation projects and dredging by others of Federal and non-Federal projects occurs in an estimated 0.08 percent or less than 2 square miles of the total 2,500 square mile surface area of Puget Sound. In the 1970-1985 period, about 9 million c.y. or approximately 36 percent of the 24.8 million c.y. of material dredged was disposed at designated unconfined, open-water disposal sites located within the Sound (Phase I and II areas).1/ This can be compared to the 250-300 million c.y. of sediment that were discharged by the rivers flowing into Puget Sound over this same period.

2.4.2 Dredged Material Disposal. In the State of Washington, major actions affecting marine waters, including dredging and disposal activities, require (at the minimum) coordination with and review by four Federal agencies (Corps, EPA, Fish and Wildlife Service (FWS), and National Marine Fisheries Service (NMFS)) and four State agencies (Ecology, DNR, Department of Fisheries (WDF) and Department of Wildlife (WDW)). Local county or municipal governments are involved through the State Shoreline Master Program.

Applicants for permits require approvals from the Corps under Section 404 of the CWA, and Ecology under Section 401, "Water Quality Certification." CZMA consistency, administered through city and county implementation requirements of the State CZM program with review and approval by Ecology, is also required. DNR coordinates disposal site selection and issues approvals to individual

1/The Phase I area contributed 16.8 million c.y. or about two-thirds of the total material dredged in Puget Sound during this period (see table 2.1).

projects for site use. A Hydraulics Project Approval is also required for disposal from the WDF and WDW.

Disposal of dredged material into open water has been a common, long standing practice throughout the State. Until 1970, open-water disposal occurred with minimal regulation regarding location, quantity, or quality. In the early 1970's, DNR created the Interagency Open Water Disposal Site Evaluation Committee (Interagency Committee) to "advise" DNR in developing guidelines for selection of disposal sites in State waters and in the selection of "approved" sites. Federal participation in this Interagency Committee was a result of informal policy rather than specific requirement or agreement. The Corps was represented at meetings of the Interagency Committee and generally cooperated with the "advisory" recommendations of the committee. Use of these approved sites has been the convention: projects that did not use the approved sites typically faced greater scrutiny and were less likely to be permitted by the State and, hence, the Federal Government.

The Corps, EPA, and Ecology traditionally have determined the technical suitability of the material to be discharged through their water quality authorities and expertise, relying on the Corps public notice procedure for notification of an activity and to obtain public and other agency review. DNR has relied on EPA, the Corps, and Ecology to assure that dredged material placed at DNR sites would not produce unacceptable adverse effects. In the past the Corps developed and implemented (in cooperation with Ecology and EPA) testing procedures for its navigation projects to determine the acceptability of dredged material for open-water disposal. Similar procedures were required of permit applicants. Such testing was typically requested of applicants by EPA with informal coordination with Corps specialists.

Ecology developed its 401 certification program during the mid- to late-1970's under the authority of the CWA and ultimately assumed a joint lead role with EPA and the Corps on testing and evaluation requirements associated with permit applications. In 1977 and 1978, Ecology in cooperation with other State and Federal agencies developed water quality controls (regulations implemented pursuant to their 401 certification authority) for dredging and disposal activities in Grays Harbor, as part of the Corps' Long Range Maintenance Dredging Program for that estuary. These regulations were formalized and issued as "Water Quality Guidelines for Dredging in Inner Grays Harbor and Lower Chehalis River," and became a modification of State water quality standards. Use of these guidelines were reflected in Corps permit decisions as State or EPA comments on the activity. Many of the requirements and evaluations specified for Grays Harbor were informally applied to other State waters (e.g., Puget Sound) by Ecology and EPA in their permit reviews.

By the 1980's it was accepted that it was necessary to meet EPA and Ecology water quality requirements (through water quality testing or monitoring, compliance with established EPA water quality criteria, and State water quality standards, etc.). For its own projects, the Corps continued to be responsible for testing and evaluation of water quality concerns (including sediment quality). Due to the number of Corps projects and the need to

coordinate with EPA and Ecology, considerable exchanges of data and expert knowledge occurred. Frequently, the results of Corps studies were used to refine EPA and Ecology testing requirements and decisionmaking. A beneficial outcome of this cooperation was the realization that the traditional definition of "water quality concerns" needed to be expanded to include consideration of potential sediment effects.

The mounting evidence in the early 1980's of pollution problems in Puget Sound focused attention on the sediments containing chemicals of concern in the urban/industrial harbors and navigation channels. Although the sediments contained these chemicals as a result of inadequate point and nonpoint pollution control, the public perceived the continuing practice of open-water disposal of material dredged from industrialized waterways to be a possible source of pollution in and of itself. Evidence that sediment chemistry was elevated above other areas at the Fourmile Rock disposal site in Elliott Bay was highlighted in the extensive media coverage of Puget Sound water quality issues that took place in 1984. Because no environmental monitoring had been performed at the existing disposal sites, there was little actual field data with which to respond to this concern. Also, agency agreement was lacking on the validity of the concern. Accordingly, public pressure was exerted to severely restrict or prohibit dredged material disposal in Puget Sound. Traditional water quality evaluation procedures alone were no longer considered sufficient for assessing the potential for pollution-related impacts at the disposal sites. Development of management techniques to address dredging and disposal concerns were just being initiated and local governments were responding to the concerns of their constituents by imposing stringent conditions on renewals of open-water site permits. Since these disposal sites could not be used without a local shoreline management permit, the impact on dredging and disposal was immediate. The two most used disposal sites, Fourmile Rock in Elliott Bay and the Port Gardner site near Everett, were closed in 1984. Fourmile Rock was reopened in 1985 and closed again on 7 June 1987.

At the request of the city of Seattle, EPA Region X developed interim criteria for use of the Fourmile Rock disposal site in 1984. In 1985, Ecology developed interim criteria for the Port Gardner disposal site, in response to a request from the city of Everett. These criteria, while never formally "adopted" by EPA or Ecology, were used by those agencies to evaluate projects proposing disposal in Elliott Bay and Port Gardner. The Corps participated in a technical advisory capacity during development of the criteria. While the Corps did not formally concur with the criteria, the criteria were considered by the Corps on a case-by-case basis.

The interim criteria for the Fourmile Rock site were formalized as a condition of the shoreline management permit issued by the city of Seattle to DNR for use of the site. These criteria were based on a "nondegradation" policy (see chapter 5) and were envisioned as temporary measures, until regionally acceptable guidelines could be developed. Reports by EPA and the PSWQA prepared in 1984, called for a regional study of dredging and dredged material disposal. In August 1985, the State adopted interim criteria for the remainder of Puget Sound that were based upon the interim criteria drafted for the Port Gardner disposal site. Since the mid-1980's, the Fourmile Rock, Port Gardner, and PSIC have been used by EPA and Ecology to determine acceptability of dredged material for open-water disposal.

2.4.3 Establishment of PSDDA. The need for dredging coupled with the following problems led to PSDDA:

o Recognition that all three of the existing DNR disposal sites could be closed by June 1988. Two of the sites were closed when the study began. While one of the sites reopened, it closed again in June 1987 when the local shoreline permit expired. All sites are now closed.

o Uncertainty with regard to proper disposal site locations. Objections were raised about the proximity of the existing Port Gardner and Fourmile Rock disposal sites to residential, public recreational, and valuable aquatic resource areas.

o Lack of consistently applied dredged material evaluation procedures. While the Section 404(b)(1) Guidelines have provided guidance and direction for Puget Sound dredged material evaluation, they have not been interpreted and applied on a consistent basis by the various regulatory agencies.

o Lack of disposal site management plans. No overall disposal site management policy has existed in the past, with few site-use compliance inspections and limited environmental monitoring of site conditions performed. The lack of monitoring has contributed to public concerns about the discharge of dredged materials. Without monitoring data it is difficult to determine actual disposal effects.

In August 1984, the Regional Administrator for EPA Region X asked the Corps, Seattle District to undertake the lead in a Sound-wide, programmatic EIS on dredged material disposal. The request was supported by the Governor of the State of Washington, the Director of Ecology, the Commissioner of Public Lands for DNR, and many others, including the PSWQA, in the form of letters and personal contacts.

In December 1984, the Corps, EPA, Ecology, and DNR began a period of intensive technical discussions to develop a joint study plan. The culmination of these efforts is the PSDDA Plan of Study, agreed to by the agencies in March 1985, which established the basis for this cooperative effort.

2.5 Study Limitations. Although PSDDA is identifying specific disposal sites and site management plans for unconfined, open-water disposal, locations for conventional upland/nearshore sites and confined disposal sites (confined aquatic or upland/nearshore) are not being specified via PSDDA. There are several reasons for this. First, while disposal in Puget Sound revolves around many regionwide and State-wide issues, disposal on land (especially for contaminated material) is very much associated with local government decisions regarding land uses. Second, the authorities of the various agencies involved in PSDDA (such as the CWA) are not as easily applied to land. And last, the State of Washington, in a recently initiated study, is addressing confined disposal options and associated testing procedures, building on the work done through PSDDA. This confined disposal study is an element of the PSWQA's Comprehensive Water Quality Management Plan (see paragraph 2.6.4).

An evaluation comparing the potential impact of dredged material disposal to the impacts of other water-related activities in Puget Sound is also beyond the scope of this study. However, due to the limited areas to be dredged and the conditions imposed by regulatory agencies, dredged material disposal at unconfined, open-water sites has very little potential for affecting the overall ecosystem of Puget Sound. This conclusion is supported by information derived from the PSDDA study and presented in study documents.

Dredged material disposal costs associated with confined disposal options have been assessed on a programmatic basis for purposes of the PSDDA Phase I alternatives analysis (see DEIS). This was done to estimate economic impacts associated with different biological effects conditions that could be used for unconfined, open-water disposal site management. In some instances, material deemed unsuitable for open-water disposal must be confined if the project is to be undertaken. As confined disposal can be 3 to 10 times more expensive, some projects may not be economically feasible if required to use confined disposal, and will not be dredged. For Federal maintenance projects the Corps may not dredge if economically and environmentally acceptable disposal sites are not available. Any significant increase in costs due to new dredged material management requirements e.g., testing, monitoring, etc. could result in marginal projects being held in abeyance.

Not addressed or precluded by PSDDA are possible beneficial uses of dredged material such as habitat development, parks and recreation, capping of problem sediments, shoreline erosion control, or use as construction fill. Obviously a significant amount of the dredged material found suitable for unconfined, open-water disposal could be put to beneficial use. The reader is referred to the U.S. Army Corps of Engineers Manual EM 1110-2-5026, "Beneficial Use of Dredged Material", for information on beneficial uses.

Also, material that may be dredged solely for the purposes of contamination cleanup, e.g., Superfund program actions, was not addressed in the PSDDA study due, in part, to an assumption that the sediments to be removed by cleanup programs would not be acceptable for unconfined, open-water disposal in Puget Sound (see paragraph 2.6.3).

2.6 Relationship to Other Studies/Regulatory Programs.

2.6.1 Puget Sound Estuary Program. PSDDA was initiated as a related, but separate, element of the Puget Sound Estuary Program (PSEP) which began in 1984. Administered jointly by the EPA and Ecology, PSEP has had two primary purposes:

- o Identification of water quality problems.
- o Promotion of cleanup actions through EPA/Ecology programs, as well as efforts by others.

PSEP is working to increase basic understanding of the complex Puget Sound estuarine ecosystem and to separate real from perceived environmental

problems. Resources are being focused on the significant problem areas. Source control and action plans for major urban embayments have been identified as meriting priority attention. The activities of PSEP are being coordinated through the PSEP Management Committee that is co-chaired by EPA, Ecology, and PSWQA. Since the establishment of PSWQA, the PSEP program has gradually been integrated to the overall effort to implement the PSWQA plan (see paragraph 2.6.2). A number of common interest technical activities were jointly funded through PSEP and PSDDA.

2.6.2 Puget Sound Water Quality Authority (PSWQA). In addition to the PSEP program, PSDDA has been closely coordinated with the PSWQA. In May 1985, the PSWQA was directed by the State legislature to prepare a comprehensive Sound-wide cleanup plan. A final plan, adopted by PSWQA in December 1986, proposes various actions to control and prevent pollution Sound-wide. According to legislative mandate, the plan contains recommendations addressing a variety of pollution related issues including nonpoint source pollution management, industrial pretreatment of toxic wastes, dredged material disposal management, and the protection, preservation, and restoration of wetlands, wildlife habitat, and shellfish beds. (For detailed information about comprehensive pollution control efforts, see the 1987 Puget Sound Water Quality Management Plan (PSWQA, January 1987) and the Final Environmental Impact Statement and Revised Preferred Plan (PSQWA, December 1986).

A key issue addressed by the PSWQA in their Puget Sound Water Quality Management Plan is the evaluation of dredging and disposal of dredged material containing chemicals of concern. The plan presents a preferred strategy with alternative programs. PSDDA is acknowledged by PSWQA as the appropriate means for dealing with unconfined, open-water disposal of dredged material. PSWQA proposes to incorporate the PSDDA Phase I area plan in an amended PSWQA comprehensive plan following the completion of the final PSDDA EIS. (Also see chapter 3 for further discussion of PSWQA and its adopted policies for dredged material management.)

2.6.3 Commencement Bay - Superfund. As a result of Ecology's Commencement Bay studies and cleanup activities at the nearshore/tidal flats Superfund site, the Corps' Waterways Experiment Station developed a decisionmaking framework for determining what materials are acceptable for various types of disposal. The decisionmaking framework considers potential contamination problems in the deepwater, intertidal, and upland areas. The Commencement Bay effort provided a useful model from which to develop dredged material evaluation procedures for PSDDA.

See paragraph 2.5 regarding the separation of dredging and disposal activities required as Superfund actions from the normal navigation dependent dredging and disposal activities that are addressed by the PSDDA study. It is not anticipated that Superfund action material will be allowed at a PSDDA disposal site.

2.6.4 Multiuser Confined Disposal. PSWQA has mandated that Ecology undertake a feasibility study of multiuser confined disposal sites as a necessary complement to the PSDDA study. The Ecology effort will build on the work done by PSDDA.

2.7 Applicability to Other Areas. While the PSDDA plan is consistent with all applicable Federal laws it is unique to the Puget Sound area because the data base used in establishing the plan is derived from Puget Sound sediments and marine organisms. Also, the public expressions considered in making decisions on the alternatives are reflective of this region's social values. Another aspect by which the region differs with all other regions of the Nation is the role that local governments play in dredged material disposal. Through the State shoreline master program shoreline permit process, local jurisdictions can condition or restrict dredging and dredged material disposal.

2.8 Indian Fishing Treaty Rights. Because dredging and the open-water disposal of dredged material takes place in waters where there are Indian commercial fishing activities, Indian Fishing Treaty Rights have been given special attention by PSDDA. There are 14 Puget Sound treaty tribes that are recognized as sovereign tribal entities with fishing rights at all "usual and accustomed grounds and stations" in Puget Sound and the Strait of Juan de Fuca (as defined in United States v. Washington [384 F. Supp. 312], known as the Phase I Boldt Decision).

Among those fishing rights protected by treaty is an unrestricted right to Indian fishing activities within reservation boundaries and a "right in common" to harvest the fisheries resources in "usual and accustomed" fishing areas historically used by Indian tribes.

In U.S. v. Washington, the treaties were interpreted to grant treaty tribes a right to harvest a share of each run of anadromous fish that passes through tribal fishing areas, including salmon and steelhead. Included within the treaties are rights to harvest for ceremonial and subsistence purposes within these areas.

The following tribes possess adjudicated fishing rights in or around the alternative disposal sites studied by PSDDA in central Puget Sound:

Tulalip Tribes
Muckleshoot Tribe
Puyallup Tribe
Suquamish Tribe
Yakima Tribe
Lummi Tribe
Swinomish Tribe

In addition, the Stillaguamish Tribe fishes by invitation from the Tulalip Tribe in the Port Gardner area.

The following tribes are not formally recognized by the Federal Government at this time for the purpose of receiving services from the U.S. Bureau of Indian Affairs, though may additionally possess fishing rights to be recognized in the future:

Duwamish Tribe (Duwamish River and Lake Washington)
Samish Tribe (area unknown)
Skykomish Tribe (area unknown)
Snohomish Tribe (area unknown)
Snoqualmie Tribe (area unknown)
Stillicum Tribe (area unknown)

In general, commercial fishing activity of the Indian tribes is concentrated from July through January of each year, with target species varying during this period. Typically fishing begins in the summer with chinook salmon and ends in winter with steelhead. The bulk of the commercial catch value is usually associated with the coho salmon fishery, which peaks in late summer and early fall. Specific fishery efforts in the Phase I areas of disposal activity are described in the FEIS as is the treatment of Indian treaty fishing concerns.

Indian treaty fishing rights have been fully taken into account in the development of the PSDDA plan (see FEIS section 2.05). To ensure tribal input, coordination was maintained throughout the PSDDA study with Indian tribes. Participation in work group meetings, direct contacts with individual tribes, and special meetings with tribal representatives, as well as exchange of correspondence, were used to identify tribal concerns that were addressed by the study team as reflected in the study documents.

2.9 Study Documents. The primary PSDDA study documents include a report containing the management plan, three technical appendixes which provide detailed information in support of the management plan, and an EIS focusing on the alternative disposal sites and site management conditions considered for the Phase I area.

o Management Plan Report (MPR) - Unconfined, Open-Water Disposal of Dredged Material, Phase I (Central Puget Sound). This document describes the study background, goal, objectives, and planning process which resulted in the PSDDA management plan. The plan is presented with expanded coverage given to major program elements. Also included is a discussion on plan implementation.

o Disposal Site Selection Technical Appendix (DSSTA). A detailed description of the disposal site identification process for future dredged material disposal is provided along with information on the existing disposal site and alternative sites considered.

o Evaluation Procedures Technical Appendix (EPTA). This appendix covers the dredged material sampling, testing, and disposal guidelines developed by the PSDDA process.

o Management Plans Technical Appendix (MPTA). Dredging and dredged material disposal permit compliance inspection requirements, environmental monitoring of disposal sites, and other site management activities are dealt with here.

o Final Environmental Impact Statement (NEPA/SEPA) - Unconfined, Open-Water Disposal Sites for Dredged Material, Phase I, (Central Puget Sound). This document presents and evaluates the selected Phase I area, unconfined, open-water disposal sites, and alternative sites considered. Also presented and evaluated for site management are the selected and alternative biological effects conditions. Comments received on the Phase I draft EIS and other supporting draft documents during the 45-days of formal public review (January 15 to March 1, 1988) are presented in exhibit C of the FEIS, together with responses by the PSDDA agencies.

CHAPTER 3. STUDY GOAL, OBJECTIVES, PLANNING PROCESS, AND MANAGEMENT PLAN

3.1 Goal. The goal of PSDDA is to provide publicly acceptable guidelines governing environmentally safe unconfined, open-water disposal of dredged material, thereby improving consistency and predictability in dredged material management. Public acceptability involves consideration of a wide range of factors. Among these are scientifically sound procedures and practicability, which includes cost effectiveness, and the extent and permanence of beneficial and/or detrimental effects. PSDDA, while specific to the Puget Sound region, is intended to be responsive to the CWA goal to "restore and maintain" the integrity of the aquatic environment and be complementary and in compliance with Section 404(b)(1) Guidelines.

3.2 Objectives. The objectives of PSDDA are as follows:

a. Identify acceptable, unconfined, open-water disposal sites.

b. Define consistent and objective evaluation procedures for dredged material to be placed at those sites.

c. Formulate disposal site management plans that will ensure adequate controls and public accountability.

The first objective involves locating disposal sites in Puget Sound that are both environmentally acceptable and economically feasible for unconfined, open-water disposal. The second objective seeks to establish a basis for disposal decisionmaking that is scientifically sound and consistent. This includes chemical and biological testing requirements for dredged materials and establishing guidelines that allow a determination to be made on the suitability of material for disposal in Puget Sound waters.

Data generated in accomplishing the first two objectives contributes to the third objective: developing a management plan for each of the open-water disposal sites. The site management plans define the roles of local, State, and Federal agencies, and address such matters as permit reviews, monitoring of permit compliance, treatment of permit violations, disposal site use restrictions, monitoring of environmental impacts, responding to unforeseen site disposal effects, plan updating, and data management.

3.3 Planning Process. The PSDDA planning process generally followed the Plan of Study (POS) adopted by the Corps, EPA, DNR, and Ecology in March 1985. The study goal, objectives, scope of effort, organization structure, tentative work plan, and budgets are contained in the POS. Also key agency understandings are set forth in the POS regarding the basis of participation in PSDDA. The public was given an opportunity to comment and influence the scope of the study through responses to a public meeting notice and a notice of intent to prepare an EIS that were issued in April 1985. Study organization and coordination/public involvement are further described below.

3.3.1 Organization. The organizational structure of PSDDA consists of four key control elements as shown in figure 3.1. These are the Policy Review Committee (PRC), Technical Steering Committee (TSC), three Technical Work Groups, and a Study Director.

The PRC is chaired by the District Engineer of the Seattle District, Corps, and includes the Regional Administrator of EPA, Region X, the Director of Ecology, and the Commissioner of Public Lands for DNR. This committee periodically meets with the Study Director to review study progress and deal with major policy issues.

The TSC provides oversight of the study, giving close review of progress and products. It also acts as a liaison with the PSEP Management Committee. During the major work activities of Phase I of PSDDA, the TSC met nearly monthly with the Study Director.

Three technical work groups, corresponding to each of the three study objectives, have responsibility for the technical studies and analysis leading to the PSDDA findings and program elements. These include: the Disposal Site Work Group (DSWG), the Evaluation Procedures Work Group (EPWG), and the Management Plan Work Group (MPWG). All four of the principal agencies serve on the work groups. The Corps chairs the DSWG and the EPWG, and DNR chairs the MPWG. Representatives of other State and Federal agencies, Corps professionals from other than the Seattle District office, Puget Sound ports, Indian tribes, environmental organizations, and private citizens also provided important contributions during work group sessions, which were conducted nearly monthly during the first year of the study. A number of consulting firms and Federal research laboratories also participated in the study through contractual arrangements/agreements.

The Study Director, the fourth element in the PSDDA organization, interfaces with the PRC, TSC, and the work groups in carrying out overall management responsibilities. The Study Director and the work groups constitute the study team.

The Corps shared with DNR the lead responsibility for preparing the Phase I area EIS to ensure compliance with both Federal and State regulations. EPA is a cooperating Federal agency and Ecology a cooperating State agency for this joint document.

3.3.2 Coordination/Public Involvement. Public involvement procedures of NEPA and SEPA were followed to ensure that issues of concern to the public were properly addressed. The PSEP mailing list of over 2,500 was used to inform interested agencies, organizations, and individuals of study activities through newsletters and public meeting notices. Articles on PSDDA were also included in the PSEP "Puget Sound Notes," a bimonthly newsletter.

During May 1985, PSDDA agencies held six public EIS scoping meetings in the Puget Sound area (cities of Seattle, Everett, Tacoma, Olympia, Bellingham, and Port Townsend). In addition, each of the three work groups conducted a number

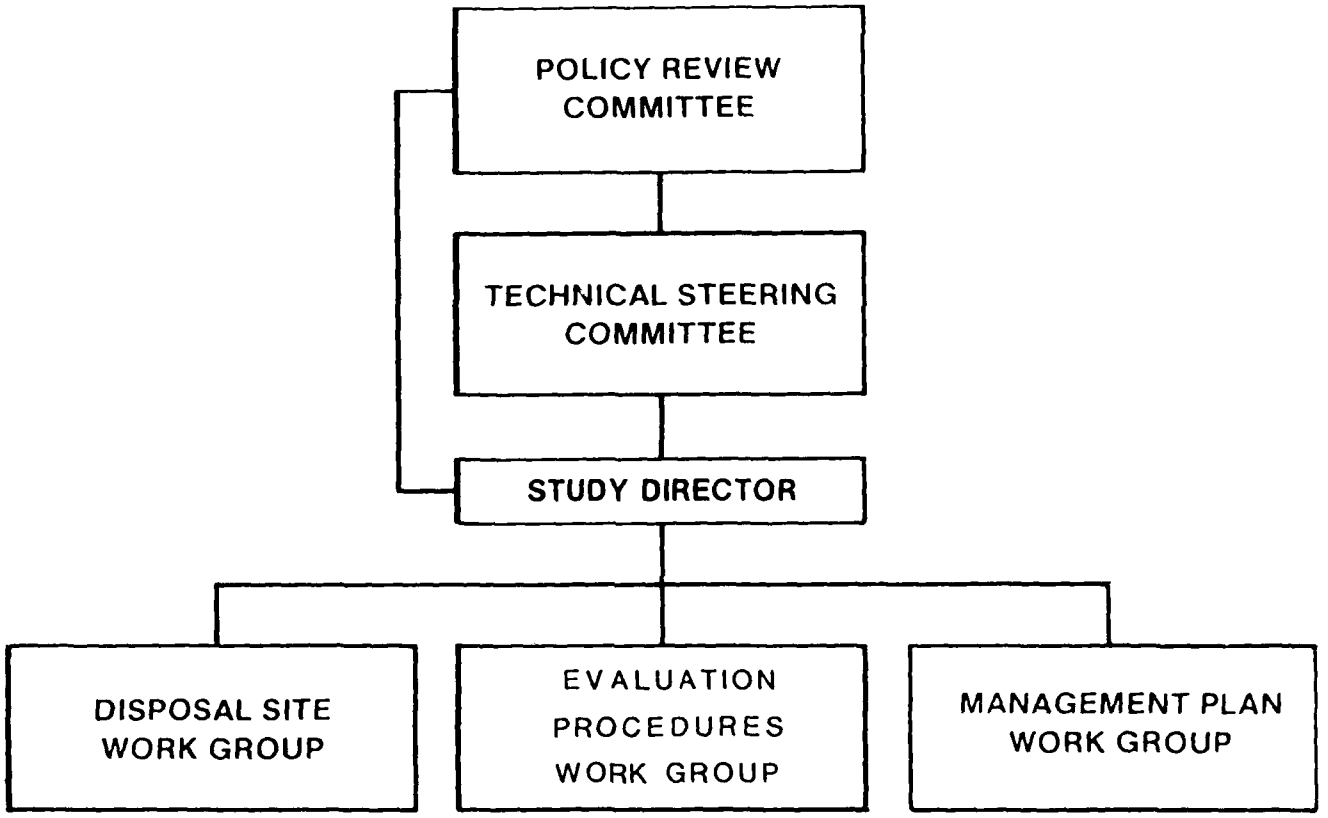


Figure 3.1 Organizational Structure
Puget Sound Dredged Disposal Analysis

of working sessions, sharing technical information and giving participants, including citizens, representatives of ports, Indian tribes, environmental groups, local governments, and other Federal and State agencies, opportunities to make recommendations on work group outputs. Routine work group meetings, as well, have been open to public participation.

Several newsletters, containing updates on the status of PSDDA and information on study findings, were published. The first newsletter included comments and issues raised at the May 1985 public meetings and the PSDDA responses. The second issue released in April 1986 contained preliminary study findings for the Phase I area. A third newsletter was distributed in January 1988 to advise the public of the availability of the draft Phase I documents and of the two final public meetings scheduled and held in February 1986.

A major display on dredging was included as part of an ongoing Puget Sound exhibit by the Seattle Aquarium. A "PSDDA" information brochure has been available to the public attending the exhibit, and to those visiting the Federal Center South offices of the U.S. Government. Three public workshops were held in May 1986 where the preliminary findings were presented and the public given an opportunity to comment on these findings. Final public meetings were held in Seattle and in Port Townsend to obtain public comments on the DEIS.

PSDDA has been coordinated closely with the PSLP and the PSWQA. Joint funding of common interest technical studies was accomplished with both of these programs. Also, the PSDDA study director and others of the study team were members of advisory committees established by PSEP and PSWQA. Similarly, staff involved in the latter two programs attended PSDDA work group sessions. Other coordination has included, but was not limited to, the following:

Federal
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
U.S. Fish and Wildlife Service
U.S. Navy
U.S. Coast Guard

State of Washington
Department of Natural Resources
Department of Ecology
Department of Transportation
Department of Fisheries
Department of Game
Department of Commerce
Department of Social and Health Services
Parks and Recreation Commission
Puget Sound Water Quality Authority

Indian Tribes
Duwamish Tribal Office
Jamestown Klallam Tribes
Lower Elwha Tribal Council
Lummi Business Council
Muckleshoot Indian Tribe
Nisqually Indian Community
Nooksack Indian Tribal Council
Northwest Indian Fisheries Commission
Point No Point Treaty Council
Port Gamble Business Committee
Puyallup Tribal Council
Sauk-Suaittle Indian Tribe
Skokomish Tribal Council
Small Tribes of Western Washington
Squaxin Island Tribal Council
Stillaguamish Tribal Council
Suquamish Tribal Council
Swinomish Tribal Council
Tulalip Board of Directors
Upper Skagit Tribal Council

Local Government
San Juan County
Mason County
Thurston County
Island County
Jefferson County
Whatcom County
Kitsap County
Snohomish County
King County
Pierce County
Clallam County
Skagit County
City of Bellingham
City of Everett
City of Seattle
City of Anacortes
City of Tacoma
City of Olympia
City of Port Angeles
Association of Washington Cities
Association of Washington Counties
Puget Sound Council of Governments (PSCOG)
Municipality of Metropolitan Seattle (Metro)

Ports
Port of Edmonds
Port of Bellingham
Port of Everett
Port of Seattle
Port of Skagit County

Ports (con.)
Port of Anacortes
Port of Port Townsend
Port of Tacoma
Port of Port Angeles
Port of Bremerton
Port of Olympia
Washington Public Ports Association

Other Public Organizations
Washington Environmental Council
Puget Sound Alliance
Greenpeace
Friends of the Earth

3.3.3 Consideration of the State of Washington Puget Sound Water Quality Authority's Plan. The Puget Sound Water Quality Plan, adopted December 17, 1986, was carefully considered by the PSDDA agencies in developing the PSDDA Management Plan. The contaminated sediment and dredging program of the plan contains a sediment program goal "to reduce and ultimately eliminate adverse effects on biological resources and humans from sediment contamination throughout the Sound by reducing or eliminating discharges of toxic contaminants and by capping, treating, or removing contaminated sediments." The PSWQA plan also adopts the following policies which are to be pursued by all State and local agencies in actions affecting sediment quality, including rulemaking, setting priorities for funding and actions, and developing permit programs:

> a. "All government actions will lead toward eliminating the presence of sediments in the Puget Sound basin that cause observable adverse effects to biological resources or pose a serious health risk to humans.
>
> b. Programs for management of dredging and disposal of sediments should result in a net reduction in the exposure of organisms to adverse effects.1/
>
> c. Remedial programs (which may include capping in place) shall be undertaken when feasible to reduce, with the intent of eliminating, the exposure of aquatic organisms to sediments having adverse effects."
>
> "1/The intent of this policy is that dredging and disposal contribute to the cleanup of the sound by allowing unconfined, open-water sites to have only low levels of contamination and to dispose of more contaminated sediments in a manner that prevents continued exposure of organisms to adverse effects. For proposals where dredging will expose contaminated sediments, project-specific mitigation measures may be required."

In developing these policies, tne PSWQA formalized a long term goal of "no observable harm to the Puget Sound ecosystem from human-caused contamination." The PSWQA plan emphasizes pollution control of all sources as the means of achieving this goal and thereby preventing future contamination of marine sediments. Development of guidelines for dealing with existing contamination is called for by the plan.

Dredging and dredged material disposal is one of over 10 key features of the PSWQA plan. However, the relative importance of dredging and dredged material disposal, in terms of water quality impacts, is considered by the PSDDA agencies and the public to be less than many of the other features such as nonpoint source pollution control, shellfish protection, and municipal and industrial discharges.

The relationship of the PSDDA management plan to the PSWQA goal and policies is discussed in the relevant sections of the FEIS.

3.4 Management Plan. The PSDDA management plan consists of all elements of dredged material management required for unconfined, open-water disposal. These are: (a) disposal sites, (b) site management conditions, (c) dredged material evaluation procedures, (d) disposal site management, (e) disposal site environmental monitoring, and (f) dredged material data management. The following chapters describe in detail the various elements of the management plan. Chapter 9 presents how the plan will be implemented, including the roles and responsibilities of each of the four PSDDA agencies.

CHAPTER 4. SELECTED DISPOSAL SITES

4.1 Introduction. This chapter describes the public, multiuser sites selected for unconfined, open-water disposal in the Phase I area. Also presented is the disposal site management condition chosen for the sites. The latter will be used to assess the technical suitability of dredged material for discharge at these sites. Dredged material evaluation procedures will assist the agencies in this assessment.

The disposal site identification process is presented in the FEIS and is described in detail in the Disposal Site Selection Technical Appendix (DSSTA), which also provides information on the three existing Phase I area disposal sites (Commencement Bay, Elliott Bay, Port Gardner) managed by DNR. While the previously designated DNR sites were not automatically considered for continued use, they were found, with minor adjustment of the disposal zones, to be generally suitable as disposal sites. However, none of the existing sites were selected for the reasons presented in the FEIS. Figure 4.1 shows the location of the existing and the alternative disposal sites identified in the PSDDA study.

Fish and shellfish and other resources that were considered in the disposal site selection process are also described in the FEIS as are the impacts to the harvest of fishery resources that could occur from use of the disposal sites.

Chapter 5 provides background on historic dredged material evaluation procedures and describes the PSDDA evaluation procedures developed in support of the biological effects condition that will be the basis for disposal site management. The Evaluation Procedures Technical Appendix (EPTA) contains a detailed presentation on this subject. The FEIS evaluates the alternative site management conditions in terms of environmental impacts and economic consequences. It also presents the No Action alternative.

4.2 Selected Phase I Area Unconfined, Open-Water Disposal Sites. The selected disposal sites are located within each of three major urban embayments of Tacoma, Seattle, and Everett, as shown in figure 4.1. These embayments are Commencement Bay, Elliott Bay, and Port Gardner, respectively. The physical parameters of a generalized disposal site in 400 feet of water are shown in figure 4.2. These include the 600-foot-radius target area, the 900-foot-radius disposal zone, and the site boundary. The target area is used for navigational control of the disposal barge to ensure that the dredged material is released within the disposal zone. The disposal site is the bottom impact area based on discharges occurring within the disposal zone. In areas of very low tidal currents the site boundary is a circle. Where tidal currents exist, the site boundary can be eliptical with the long axis of the site reflecting the additional distance of dredged material settlement due to current transport. A noncircular shape can also be the result of bathymetry where bottom slopes can influence the configuration of the impact area.

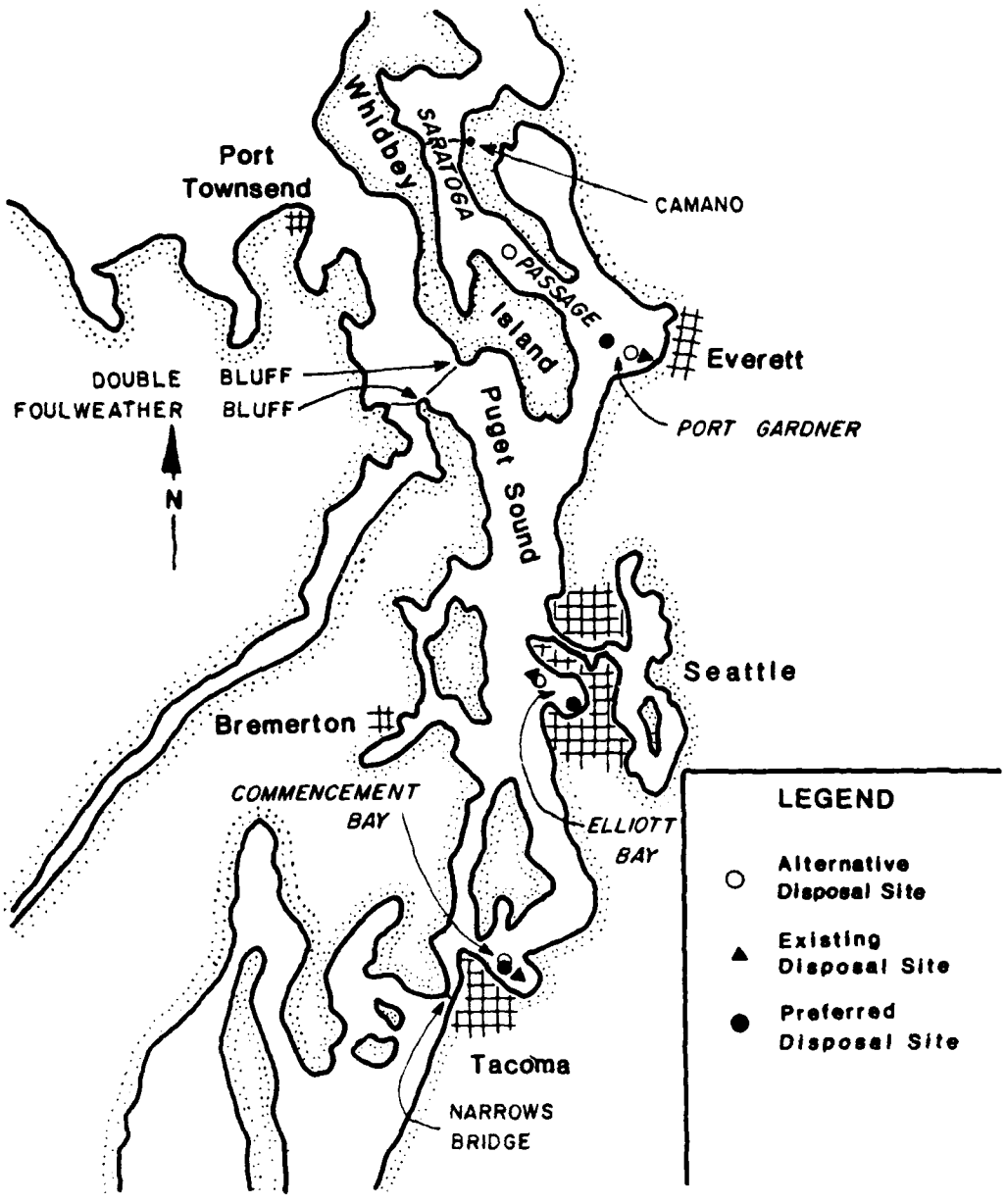
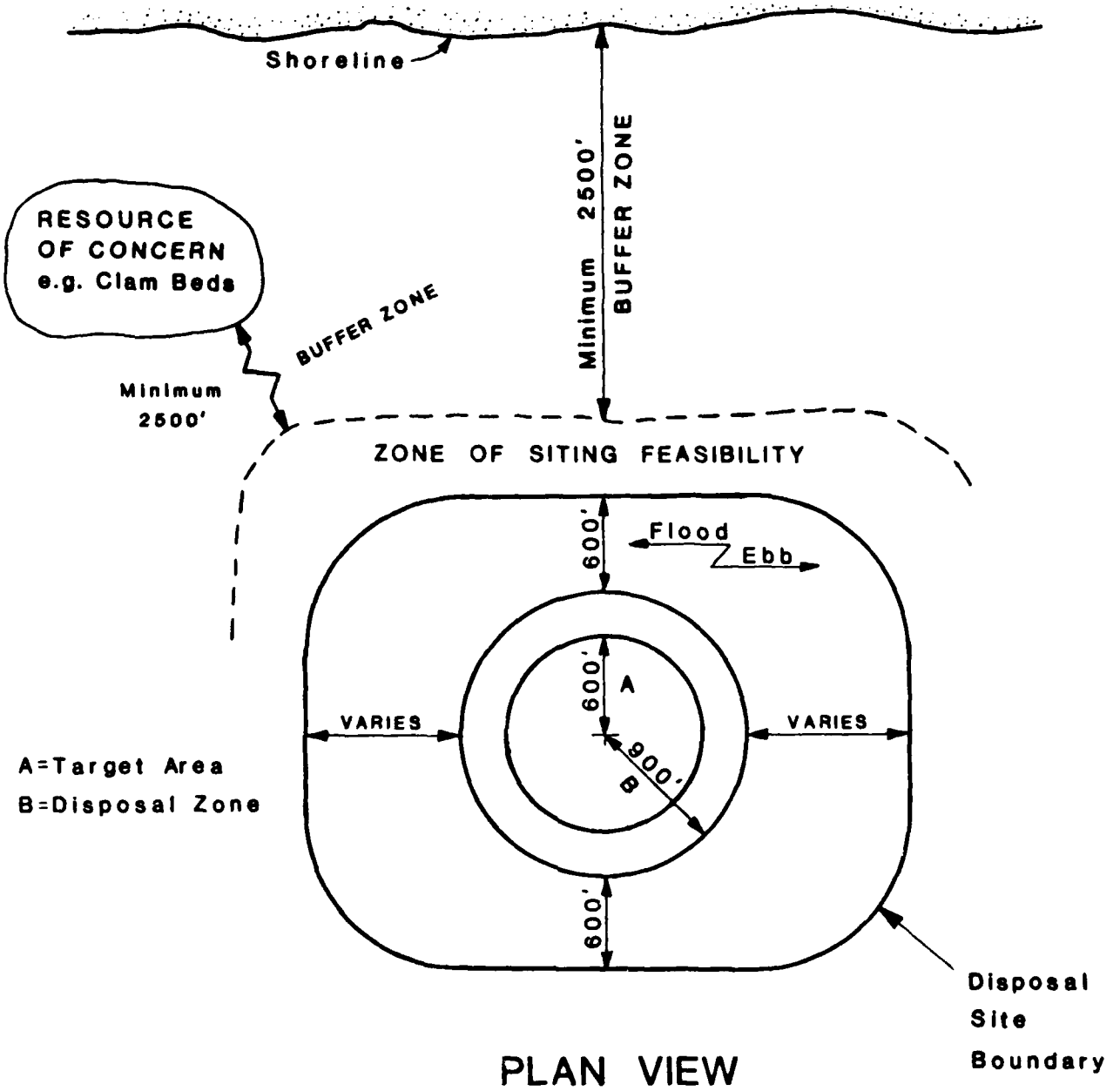


Figure 4.1 Disposal Site Locations
Phase I Area



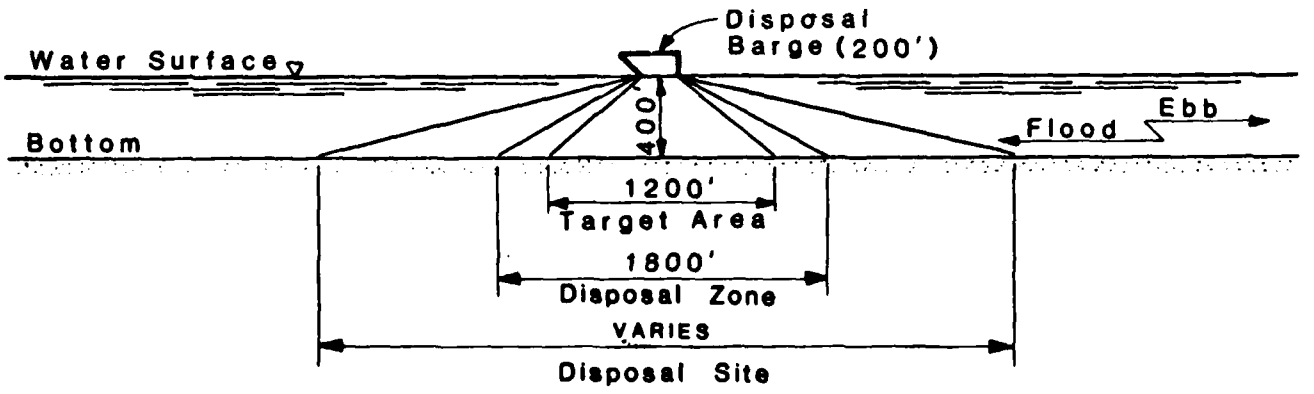


Figure 4.2 Disposal Site Parameters

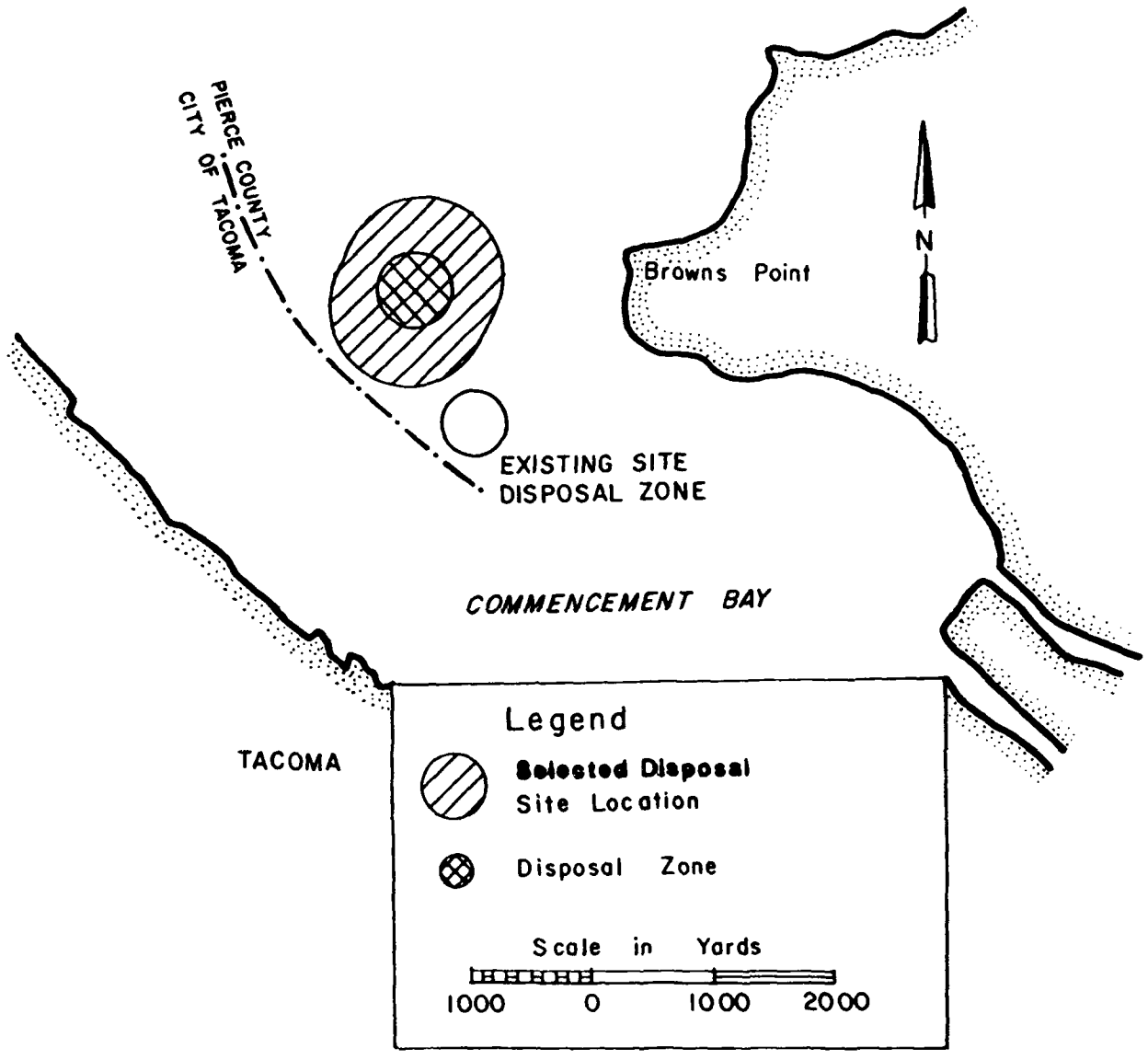


Figure 4.3 Commencement Bay Disposal Site

4.2.1 Commencement Bay. The center of the disposal zone of the preferred site is located about 1 mile west of Browns Point (see figure 4.3) and about 0.9 mile northwest of the center of the existing disposal site. The preferred site varies in depth from 540 to 560 feet, is generally depositional in nature, and covers an area of about 310 acres. The bottom slope at the site is relatively flat.

4.2.2 Elliott Bay. The center of the disposal zone of the preferred site is located in a low current area about 1 mile off the mouth of the Duwamish River and approximately 3 miles southeast of the center of the existing Elliott Bay Fourmile Rock disposal site (see figure 4.4). The 415-acre preferred site is egg-shaped due to the sloping bottom. The south and the north edges of the site lie in 200 feet and 360 feet of water, respectively.

4.2.3 Port Gardner. The center of the disposal zone of the preferred site is located approximately 3 miles west of Everett Harbor, 2.2 miles southeast of Gedney Island, and about 1.7 miles northwest of the center of the existing Port Gardner disposal site (see figure 4.5). The preferred disposal site covers about 318 acres. Water depth is approximately 420 feet, and the bottom slope is relatively flat.

4.3 Biological Effects Condition for Disposal Site Management. The PSDDA study evaluated four alternative biological effects conditions that could be used in disposal site management. These alternatives described four degrees of increasing potential effects on biological resources at the disposal site, from "no effects due to sediment chemical concentrations" to "major effects due to sediment chemical concentrations." The alternative labeled "minor adverse effects" has been selected for purposes of disposal site management (Site Condition II). This alternative allows, as an upper condition, adverse effects within the site boundaries which are predominantly sublethal and develop only from long-term exposure. In laboratory terms, dredged material creating this condition does not result in significant toxicity to sensitive test species exposed to the sediment to be dredged or significant bioaccumulation. It should be recognized that the bulk of dredged material placed at the disposal sites is expected to produce no adverse biological effects due to chemicals. Consequently, actual effects at the disposal site are expected to be less than described for the selected site condition. This is viewed as a conservative approach to site management.

The dredged material evaluation procedures used to assess the technical suitability of the material for unconfined, open-water disposal are designed to ensure that the selected site condition will not be exceeded. These procedures (described in chapter 5) will change as new information is received and the testing technology evolves. However, the site management objective will remain constant over the forseeable future.

Specific project evaluations, as required under specific Federal and State authorities, will establish actual dredged material volumes that can be placed in unconfined, open-water disposal sites. However, based on the selected site management condition, and using reasonable assumptions and best-available sediment chemistry data, an estimated 11.2 million c.y. of future dredged material could be found acceptable for unconfined, open-water disposal through the year 2000 (about 60 percent of the 19.4 million c.y. that might be

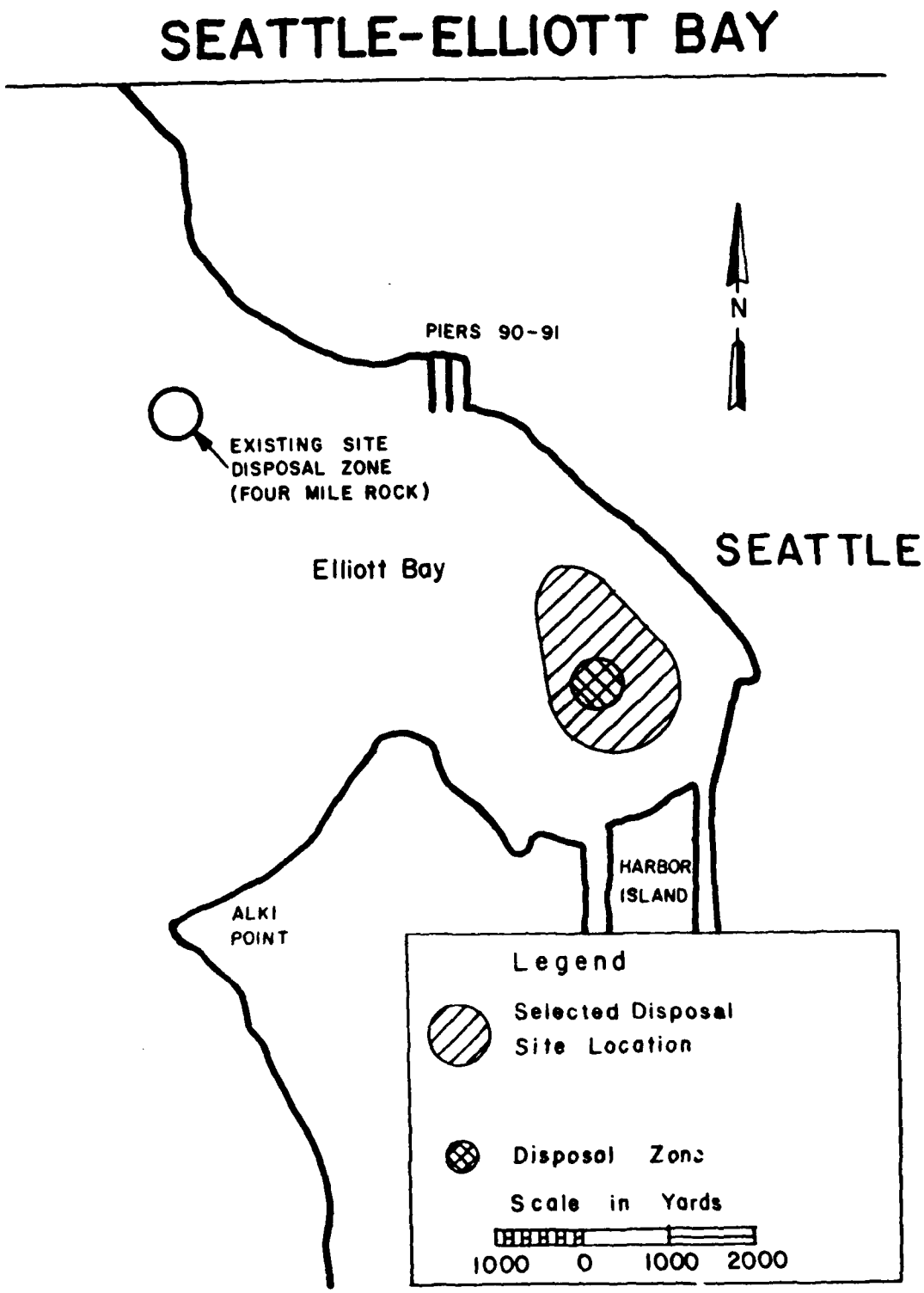


Figure 4.4 Elliott Bay Disposal Site

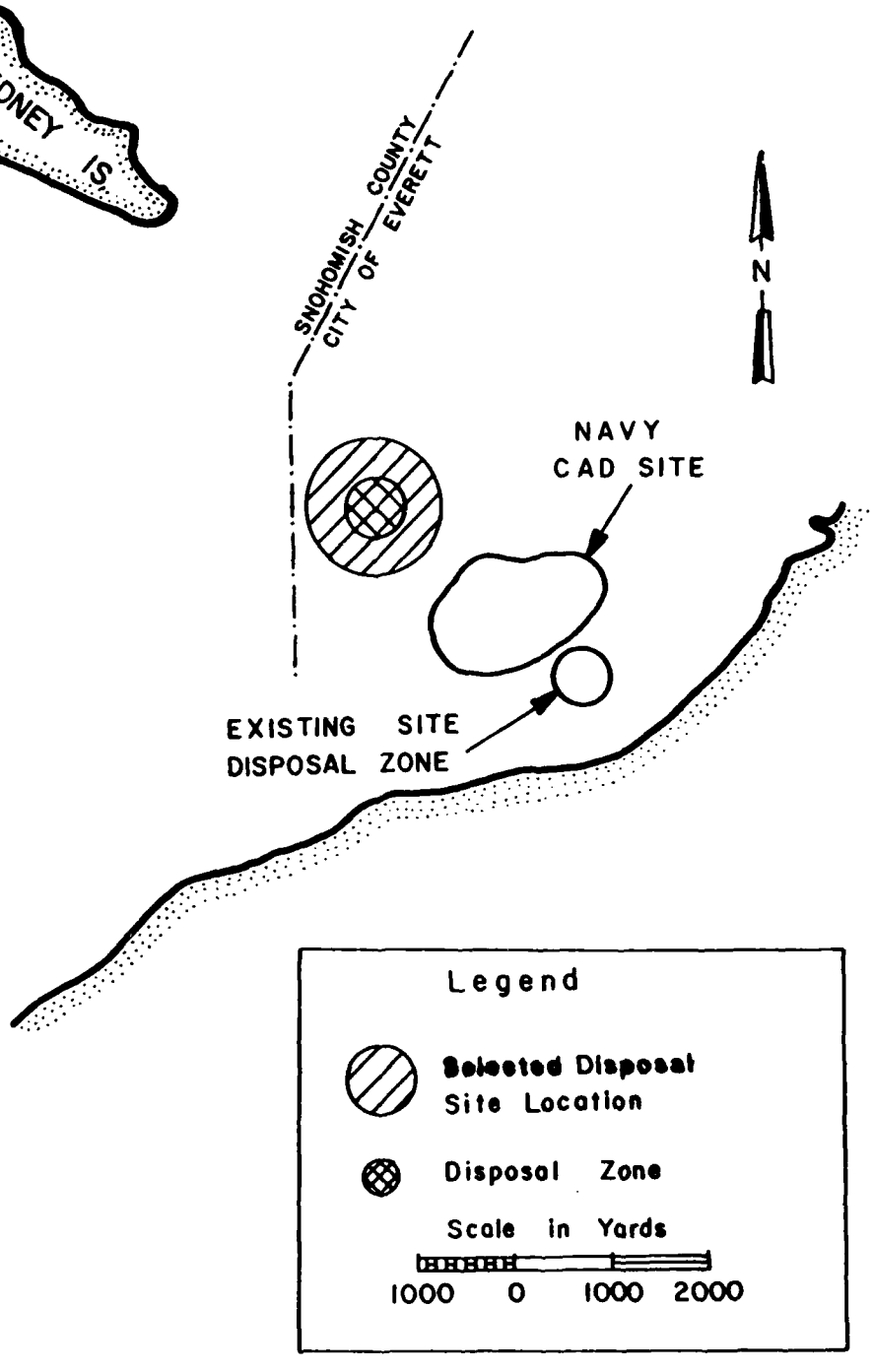


Figure 4.5 Port Gardner Disposal Site

considered for disposal at the Phase I area PSDDA sites).1/ This compares with 6.8 million c.y. of dredged material actually placed in Phase I waters over the past 15 years. In the past not all acceptable material was placed at public disposal sites. Some was used for landfill or other beneficial purposes. This is expected to be true in the future, too. Further discussion of the consequences of the selected site management condition is contained in the FEIS. Detailed assumptions and calculations, shown in the EPTA, are based on present conditions. It is anticipated that as source control improves and project-specific experience and data become available, the portion of future dredged material that is acceptable for unconfined, open-water disposal will increase.

1/This excludes the Navy Homeport project (see table 2.2). Nationally 90 to 95 percent of all dredged material is considered to be suitable for unconfined, open-water disposal (U.S. Congress, 1987, Office of Technology Assessment, Wastes in Marine Environments. U.S. Government Printing Office.) However, the Phase I area contains major urban and industrialized centers of development where significant waste discharges have historically occurred.

CHAPTER 5. PSDDA DREDGED MATERIAL EVALUATION PROCEDURES

5.1 Introduction. This chapter briefly summarizes the dredged material evaluation procedures developed during the PSDDA study and describes how the evaluation procedures would be applied in determining the acceptability of material for unconfined, open-water disposal at sites in central Puget Sound. The procedures include physical, chemical and biological tests for evaluating dredged material. A final section presents case studies that compare costs actually incurred for the projects evaluated to the costs that might have been incurred had the projects been subject to the PSDDA evaluation procedures. Further details of the PSDDA evaluation procedures, including the disposal guideline values, are contained in exhibit A of this report and in the Evaluation Procedures Technical Appendix (EPTA). Citations shown in this chapter are listed in EPTA. Also contained in EPTA are comparison figures and tables relating sediment chemistry concentrations of the Fourmile Rock Interim Criteria (FRIC) and Puget Sound Interim Criteria (PSIC) to sediment chemistry concentrations proposed for use in the PSDDA evaluation procedures.

The agencies involved in the PSDDA study recognize that the recommended evaluation procedures represent a combination of tests and guidelines based on current knowledge. A combination of tests is consistent with regulatory requirements, which specify that no single test can appropriately address all assessment needs. Annual evaluations will be made of permit decisions, scientific state-of-the-art testing methods and regulatory guidelines, and results of the site environmental monitoring program in order to ensure that the most environmentally appropriate and cost effective evaluation procedures are being employed for dredged material management in Puget Sound.

5.2 Background and Overview of Dredged Material Assessment. The CWA Section 404(b)(1) Guidelines (40 CFR 230) outline the basic requirements for determining whether dredged material is suitable for disposal in water. In general, the Guidelines specify that disposal of dredged material in water must not result in an "unacceptable adverse impact" to the aquatic ecosystem. To achieve this, four conditions of compliance must be met before disposal is permitted (see chapter 1, section 1.2.3). To assist in determining compliance with the conditions, the Guidelines provide guidance for testing and evaluating the impact of dredged material disposal.

In Puget Sound, several approaches have been taken to evaluate the potential for unacceptable adverse effects due to the disposal of dredged material at unconfined, open-water sites. Prior to 1984, the Section 404(b)(1) Guidelines for testing and evaluation of dredged material were applied to navigation projects on a project-by-project basis. Testing that was conducted usually emphasized water quality effects, using a procedure known as "elutriate testing" to determine if chemicals were released into the water column during dredging or disposal. In Puget Sound, the effects of chemicals of concern that remained bound to the sediments in the disposal site were often not directly studied, and, as a result, the potential consequences to the Sound's ecosystem were not fully known.

The lack of fully consistent evaluation procedures, or specific objective decision criteria led, in part, to the establishment of interim disposal criteria by EPA and Ecology for the Fourmile Rock disposal site in Seattle's Elliott Bay in 1984 and the Port Gardner site near Everett in 1985. The Fourmile Rock criteria became a condition of the local shoreline permit issued by the city of Seattle to DNR and the Port Gardner criteria a condition of the city of Everett permit for the existing Port Gardner site. Subsequently, in 1985, Ecology developed the PSIC to ensure that the other Puget Sound disposal sites remained permitted by local authorities. These criteria have been used in the interim pending development of regional Sound-wide guidelines for dredged material disposal.

Much of the current knowledge concerning the impacts of dredged material disposal in open water is derived from a series of studies conducted by the Corps of Engineers Waterways Experiment Station (WES). Since the Dredged Material Research Program (DMRP)1/ was authorized under the 1970 River and Harbor Act, several research and applied programs have been instituted by WES. These include the DMRP, the Long-Term Effects of Dredging Operations Program (LEDO), and the Field Verification Program (FVP). Together these programs have addressed a wide array of topics concerning the dredging and disposal of dredged material, including the effects of dredging operations on water column and benthic (bottom) environments, description of dredged material behavior during and following disposal, design and operation of confined disposal sites, and field investigations of the effects of disposal operations. This work has also addressed beneficial uses of dredged material, including use of dredged material for habitat development. In addition to the work developed under the direction of WES, other sources of information on the impacts of dredged material disposal are available from the open literature. Information on dredging can be found in symposium proceedings such as the International Ocean Disposal Symposium, Symposium on Coastal and Ocean Management, and Dredging and Dredged Material Disposal Symposium (sponsored by American Society of Civil Engineers). In addition, major dredging studies have been undertaken in the Northwest and Puget Sound region which have provided a further understanding of dredging and dredged material disposal in this area. The studies included the Anacortes Dredging Study (1970), Northwest Dredging Effects Study (1974), the Budd Inlet, Olympia Study (1975), the Grays Harbor Dredging Effects Study (1976-1977), and the Duwamish River Sediment Study (1976-1980).2/ More recently, the U.S. Congressional Office of Technology Assessment (OTA) published a report dealing with waste disposal in marine environments.3/ That report addresses dredged material management

1/Saucier, R. T., et al. 1980. Executive Overview and Detailed Summary. Technical Report DS-78-22 (NTIS No. AD-A074531) U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

2/Published reports are available for the Grays Harbor and Olympia studies. See: U.S. Army Corps of Engineers, Seattle District, January 1977, Maintenance Dredging and the Environment of Grays Harbor Washington, and U.S. Army Corps of Engineers, Seattle District, December 1973, Evaluation of Effects of Channel Maintenance Dredging and Disposal on the Marine Environment in Southern Puget Sound, Washington.

3/U.S. Congress, 1987, Office of Technology Assessment, Wastes in Marine Environments. OTA-O-334, Washington, D.C.: U.S. Government Printing Office.

from a national perspective as one of many marine water inputs and impacts. It and other OTA supporting documents cite an extensive body of literature dealing with this subject. The following brief review discusses work which addressed the impacts of dredged material disposal on the aquatic environment.

For most dredged material nationwide, environmental effects of disposal in open waters are largely the result of physical impacts associated with disposal. Physical impacts include complete burial of benthic communities existing in the disposal zone. Recolonization of a disposal site can be rapid, providing the material is of similar grain size as the native sediments. More persistent physical impacts affecting benthic organisms can occur where dredged material is placed on substrates of dissimilar grain size, with impacts the greatest when dredged material containing a high percentage of sand is placed on a mud substrate and covers mud-dwelling organisms unsuited for living in sandy sediments (Maurer, et al., 1978, 1981a, 1981b, 1982; for detailed citations, see EPTA). The concentration of chemicals in sediments may also affect rates and the general success of recolonization at the disposal site.

Impacts to the water column from dredged material disposal have generally been of short-term duration, and typically result from increases in turbidity and the release of chemical constituents such as ammonium, manganese, iron, and orthophosphates (Blom, et al., 1976; Chem, et al., 1976; Jones and Lee, 1978). Under most circumstances, data indicate that changes in water column properties brought about by the release of dredged material into the aquatic environment are temporary and are not considered to be sources of significant impact to aquatic organisms. During monitoring of physical and chemical parameters in the water column during and following disposal of material at the Duwamish waterway disposal site, it was concluded that no long-term effects resulted from the disposal operations (Baumgartner, et al., 1978). Parameters measured during these field investigations included suspended solids, pH, ammonium, nitrites, nitrates, and several heavy metals.

In general, increases in turbidity (e.g., increases in suspended particles) due to dredged material disposal are also not thought to cause significant or long-term impacts to aquatic species. Turbidity studies by the Corps (Peddicord, et al., 1975; Peddicord and McFarland, 1978; and McFarland and Peddicord, 1980) have shown lethal concentrations of suspended dredged material to be at least an order of magnitude higher than maximum water column concentrations observed during dredging operations. However, other research (Gentile, et al., 1985) has found that the concentration at which suspended particles produce lethality in crustaceans decreases as the concentration of chemicals bound to the particles increases. Crustaceans (mysid shrimp and amphipods) exhibited lethality to contaminated suspended sediments at concentrations significantly lower than that required when the same species were exposed to clean sediments having similar grain size distribution to the contaminated material.

The significance of the findings of Gentile, et al. (1985) to benthic populations near a dredged material disposal site are unknown. Baumgartner,

et al. (1978) reported small, though persistent increases in suspended particle levels near the bottom during long-term monitoring of a Duwamish River waterway disposal site. The laboratory work of Gentile, et al. (1985) suggests that disposal of contaminated dredged material could result in some impacts to benthic species if the material were to result in persistent increases in suspended particle overflows in and around the disposal site.

Impacts of chemicals, especially chronic (long term) impacts, are generally thought to be due to the uptake, accumulation, and (for some chemicals) metabolic transformation of the compound into more toxic forms. The biological availability of chemical compounds associated with some dredged materials will greatly influence the rate at which these compounds will be accumulated. Early work under the DMRP on metal availability and accumulation in aquatic species indicated that metals were not generally taken up by the test organisms (Neff, et al., 1978). When accumulation did occur, the levels to which the metals were concentrated often varied from one sampling period to another and were quantitatively marginal.

Recent research on bioaccumulation from dredged material indicates that organics, as a general class of compounds, are more biologically available to aquatic organisms than are metals (Lake, et al., 1985). Lipophilic (fat-seeking) organic compounds (those that have a high affinity for lipids (fats)) appear to be readily bioaccumulated from sediments to which they are associated. In both laboratory experiments and field evaluations, clams and burrowing worms have been found to accumulate significant concentrations of organic compounds that had been associated with dredged material.

In conclusion, past laboratory and field research efforts have largely indicated that the disposal of coarse-grained dredged material will not result in unacceptable adverse effects to the receiving environment. This is especially true if the material being dredged is without measurable levels of chemicals of concern. However, sediments dredged from the waterways near major metropolitan areas are typically fine-grained and merit closer assessments prior to disposal at unconfined, open-water sites.

5.3 Implementation of the PSDDA Evaluation Procedures. Responsibilities of the PSDDA regulatory agencies under Section 404 or Section 401 of the CWA will be accomplished in accordance with each agency's authorities and policies. The PSDDA dredged material evaluation procedures will be applied by each regulatory agency consistent with these authorities and policies. This chapter presents the procedures as an overall approach which can meet the case-by-case requirements of both Section 404 and Section 401. Most elements of the PSDDA procedures are common to both authorities. However, some elements are unique to either Section 404 or Section 401 requirements. Those seeking approval for unconfined open-water disposal will need to meet both requirements, i.e., undertake the full suite of PSDDA tests, as each agency determines is applicable.

The Corps of Engineers requirements for the evaluation of dredged material proposed for unconfined disposal in Puget Sound waters, as specified in

Subpart G of the Section 404(b)(1) Guidelines, will be met primarily by the Section 404 component of the PSDDA evaluation procedures. The Section 404 component of the PSDDA procedures are, and will be, applied consistent with the national Corps procedures described in chapter 1. The Corps will address other aspects of the Section 404(b)(1) compliance, such as impacts on navigation and national commerce and avoidance and minimization of impacts, including mitigation of unavoidable impacts and alternatives analysis on a case-by-case basis.

The EPA will rely on the PSDDA evaluation procedures as the basis for preventing significant degradation of the aquatic environment as required by the Section 404(b)(1) Guidelines. These procedures represent the testing approaches and procedures, allowed under the Guidelines, which EPA would require during the evaluation of dredged material. Other aspects of the Section 404(b)(1) compliance, such as avoidance and minimization of impacts, including mitigation of unavoidable impacts, will also be addressed by EPA, during comprehensive reviews, on a case-by-case basis.

Ecology will apply the PSDDA evaluation procedures in assessing applications for Section 401 Water Quality Certification. Initially, the procedures will be treated as guidelines. However, depending on actions that might be taken by the Puget Sound Water Quality Authority (PSWQA) in their adoption of the PSDDA management plan as a feature of the PSWQA Water Quality Management Plan, the PSDDA evaluation procedures may later be adopted as a State regulation.

5.4 Development of the PSDDA Dredged Material Evaluation Procedures. As detailed in EPTA, the PSDDA evaluation procedures specify sampling, chemical and biological testing, and disposal guidelines (test interpretation) for unconfined, open-water disposal of dredged material. An overview of the more important features of the PSDDA evaluation procedures are presented in this section to provide insight into their general development. A description of each aspect of the procedures is presented in section 5.5 of this chapter. This latter discussion presents the evaluation procedures in the order in which they would be chronologically applied to a proposed dredging project.

Dredged material is a complex mixture of soil, minerals, water, and inorganic and organic chemicals that can interact with the environment in ways that are both predictable and difficult to predict. These interactions may in some instances result in unacceptable adverse effects on biological organisms exposed to the dredged material. It is also possible for dredged material to produce beneficial effects. Procedures for evaluating the potential for unacceptable adverse effects to occur are essential to proper dredged material management.

Evaluation procedures include sampling and testing requirements and disposal guidelines for determining if dredged material is suitable for unconfined, open-water disposal, or for determining if confined disposal is warranted.

Five steps were taken in establishing the PSDDA procedures, as follows:

a. Step 1. Selection of the general management approach to dredged material evaluation.

b. Step 2. Definition of various degrees of adverse biological effects that might occur at the sites (referred to as "biological effects conditions for site management" or "site conditions").

c. Step 3. Development of dredged material evaluation procedures as a means to avoid exceeding the site condition by:

(1) specifying chemical and biological testing requirements and

(2) defining disposal guidelines (test interpretation), including biological response guidelines (for biological tests) and sediment quality values (for chemical tests).

d. Step 4. Assessment of the environmental and economic consequences of the different alternative site conditions.

e. Step 5. Identification of the preferred biological effects condition for site management in the Phase I area of PSDDA.

The PSDDA agencies recognized that the identification of dredged material that is suitable for unconfined, open-water disposal under Section 404(b)(1) Guidelines is not a simple, "black or white" decision. Complicating the development of a standard definition is the uncertainty in scientific understanding of cause and effect relationships between sediment contamination and biological response. This uncertainty leaves a large "gray area" in terms of the biological effects that could be allowed at the unconfined, open-water disposal sites and still not result in unacceptable adverse effects. Within this "gray area," what constitutes unacceptable also depends upon individual perspective, the role of various regulatory agencies, and a combination of regional administrative factors (e.g., defining an acceptable reference area).

A number of different alternative definitions of acceptable and unacceptable adverse effects that could be expected at the disposal sites were considered. The "gray area" was divided into three different biological effects conditions for site management, each describing the boundary between "acceptable" and "unacceptable" adverse environmental effects on biological resources. The alternative conditions differ by the degree of potential adverse effects on resources potentially allowed at the disposal site, ranging from "no adverse effects due to sediment contamination" to "moderate adverse effects due to sediment contamination." (Site conditions I to III, table 5.1.)

Site condition I (no adverse chemical effects on biological resources), site condition II (minor adverse chemical effects), and site condition III (moderate adverse chemical effects) all define conditions which, depending

TABLE 5.1

ALTERNATIVE BIOLOGICAL EFFECTS CONDITIONS FOR
MANAGEMENT OF THE UNCONFINED, OPEN-WATER DISPOSAL SITES

Site Condition I:	"No adverse effects" on biological resources due to the presence of chemicals of concern. No species will be affected due to unacceptable sediment quality within the site in the short (acute) or long (chronic) term.
Site Condition II:	Potential for "minor adverse effects" on biological resources due to presence of chemicals of concern. Some species may be affected within the site after long-term exposure to sediments (only sublethal effects are anticipated).
Site Condition III:	Potential for "moderate adverse effects" on biological resources due to presence of sediment chemicals of concern. Many species may be affected within the site from both short- and long-term exposure to sediment contamination (both lethal and sublethal effects are possible).

upon individual and regional interpretation, could be argued to comply with the Section 404(b)(1) Guidelines. Each of these options accordingly was carried forward for detailed investigation.

Selection of the management condition for the unconfined, open-water disposal sites was based on a review of environmental effects and cost factors. The analysis of adverse effects that might result with each alternative site condition also considered the possible adverse effects of disposal of material that is not acceptable for unconfined, open-water disposal. The environmental tradeoffs, or "total" effects, of dredging and disposal of all material was weighed in the selection of the preferred biological effects condition for site management.

The preferred alternative labeled "minor adverse effects" was selected for purposes of disposal site management (site condition II). This alternative allows effects within the site boundary that are predominantly sublethal and developing only after long-term exposure. In laboratory terms, dredged material meeting this definition does not result in "significant acute toxicity" to sensitive test species exposed to the sediment to be dredged.

The dredged material evaluation procedures used to assess the acceptability of the material for unconfined, open-water disposal are designed to ensure that the site condition selected for disposal site management is not exceeded.

The PSDDA evaluation procedures base the definition of acceptable dredged material primarily on consideration of biological effects and human health effects that might occur at the disposal site, using direct chemical and biological tests (or comparable existing data) on dredged material as described below.

5.4.1 Biological Testing. When required, biological testing includes short-term (acute) tests for bulk sediment toxicity to marine organisms and/or possible adverse effects to the water column (acute bioassays) and longer tests to determine whether the chemicals accumulate in tissues of marine animals (bioaccumulation tests) (see figure 5.1).

Several acute bioassays are specified: an amphipod test, a juvenile bivalve test, larval tests (used for sediment toxicity and/or for assessing water column effects), and a bacterial bioluminescence test (commonly referred to as the Microtox test). Use of multispecies tests attempts to account for the diversity of aquatic species present in Puget Sound. Of these four tests, the amphipod, juvenile bivalve and larval tests pertain to conducting ecological evaluations pursuant to both the Section 404(b)(1) Guidelines and Section 401 water quality certification reviews. The Microtox test is solely required for Section 401 reviews.

A bioaccumulation test, required under certain circumstances, is intended to provide information about the potential of chemicals to be of concern to human health. The test consists of a 30-day sediment exposure of bivalves with subsequent analysis of their tissues for chemicals of human health concern. In addition to their use for bioaccumulation, bivalve mortality will be monitored during the 30-day exposure period to provide toxicity data on potential chronic exposures. See EPTA for further discussion of the basis for bioaccumulation testing.

The proposed biological tests were chosen because they are considered available, proven, sensitive, generally accepted, and provide interpretable endpoints (e.g., mortality, or quantitative tissue concentrations that can be incorporated into a health risk analysis) for assessing sediment toxicity and/or the effects of dredged material disposal. Multiple tests have been recommended to provide animal diversity that might address the different sensitivities of various species to different chemicals.

The Section 404(b)(1) Guidelines identify the types of potential adverse effects to the aquatic environment that must be considered in determining compliance with the guidelines. These include an assessment of the potential short- and long-term (chronic) effects of the dredged material discharge to aquatic communities, as well as the potential for sublethal effects such as impairment of animal growth and reproduction.

Regulatory Program	Section 401 SEPARATE TESTS	Sections 401/404 TESTS IN COMMON	PSDDA (COMBINED SECTIONS 401/404 TESTS)
Acute Tests	Microtox	Amphipod Juvenile Bivalve Larval Test (1)	Amphipod Juvenile Bivalve Larval Test (1) Microtox
Bioaccumulation for Human Health		Adult Bivalve	Adult Bivalve

(1) The larval species, depending on the test methods and interpretation, can be used in either a water column bioassay (for Section 404 evaluations) and/or a sediment toxicity test (for Section 401 reviews). Though the sediment larval test will be conducted whenever biological testing is required, the water column larval test will only be required when water column effects are of concern (see section 5.5.7).

Figure 5.1. PSDDA biological testing requirements.

While there are some biological tests that can provide a partial assessment of sublethal or chronic effects, they are not sufficiently developed or cost effective for routine application. The proposed laboratory tests include some measures of sublethal effects. The oyster larvae test provides a measure of abnormal development; and the Microtox test also measures reduced light production due to nonlethal effects. The observed condition of animal communities in Puget Sound (benthic infauna) relative to the degree of sediment chemical concentrations was included as a component of the data base used in developing the chemical disposal guidelines. To the extent that the benthic community was responding to any adverse sublethal or chronic effects to growth and reproduction due to sediment chemical concentrations, these were also expressed in final guideline values. While benthic community condition can be considered in the field data, this information cannot be obtained from a routine laboratory test.

During Phase I of the study, research was conducted in an attempt to develop an improved sublethal and chronic bioassay for sediments. Unfortunately, the research did not result in a test that could replace the proposed biological tests (details are contained in EPTA). Further assessment of testing procedures for sublethal and chronic effects is planned for Phase II of the study. However, the proposed suite of biological tests, in concert with the chemical disposal guidelines, are considered the best available at this time, and fully adequate to assess the possible effects of sediment chemicals of concern.

5.4.2 Relation of Chemical Tests to Biological Testing and the Definition of Significant Acute Toxicity. Proposed chemical testing consists of sediment chemical analysis for chemicals identified to be of concern for dredged material in Puget Sound, including both heavy metals and organics. The chemicals to be analyzed were identified by considering toxicological information available for chemicals known to be found in Puget Sound sediments. The selected chemicals are associated with potential for adverse biological effects, have been discharged in the sound, have the potential to remain toxic for a long time in the environment, and have the potential for entering the food web. In Puget Sound, chemical testing requirements will be the same for both Section 404(b)(1) evaluations and Section 401 water quality certification reviews.

A tiered testing approach is proposed. Rather than always conducting both chemical and biological tests, the need for biological testing will be based on the results of sediment chemical analyses. If the results of chemical tests or existing data indicate low levels of chemical contamination, the dredged material is considered suitable for unconfined, open-water disposal and no further testing is required. For dredged material with very high concentrations of chemicals of concern, biological testing is mandatory if open-water disposal is proposed or considered. However, the dredger may not find this testing to be worth pursuing, as the material is unlikely to meet the biological response disposal guidelines.

In the Puget Sound area, recent and extensive field sampling by a variety of agencies for various regulatory and management programs, has generated a

comprehensive sediment chemistry/biological effects data base. This data base, compiled at the beginning during development of the PSDDA study, contains information on a variety of sediments collected throughout Puget Sound. The urban/industrial waterways are represented, as are "clean" reference areas and most of the major dredging areas in the central part of the estuary. Information currently contained in the data base represent over 190 stations, sediment chemical analyses on 71 chemicals, information on a variety of conventional sediment parameters, and the results of multiple species bioassays. The bioassays (which varied among stations within the data base) include an amphipod test, an oyster larval test, and a Microtox test. Also included in the data base are information about the health of the benthic community present at many stations where sediment samples were taken for chemical analysis and bioassay evaluation (see EPTA for additional details).

In developing the evaluation procedures, the Puget Sound data base was accepted as valuable in revealing general relationships between biological effects and specific concentrations of sediment chemicals. However, it is important to note that conditions observed in sediments taken from urban waterways will not necessarily be duplicated if the same sediment is discharged at a deepwater site in Puget Sound. Extrapolation from site-specific correlations between sediment chemistry and biological effects, to predicted effects at the disposal site is especially uncertain when using empirical data generated from nondisposal areas. However, because the toxicity of dredged material is a principal factor in determining the acceptability of sediment for unconfined, open-water disposal, sediment bioassay results were accepted as important to developing guidelines for use in evaluating the relative toxicity of dredged material.

Although there are a variety of factors, including natural variability and nonsediment anthropogenic (human caused) (e.g., ship passage, water quality, etc.), that can influence the condition of the bottom-dwelling community, the incorporation of benthic community data was also justified. The decision to consider benthic effects information during development of the PSDDA evaluation procedures was based on evidence that community structure does have a relationship to degree of chemical contamination (and other factors) and, that inclusion of the data would provide some degree of protection against unacceptable adverse impacts unaccounted for by single species bioassays or limited chemical analyses.

During development of the PSDDA chemical disposal guidelines, sediment quality values developed by different approaches were tested to determine their reliability in correctly predicting toxicity in the Puget Sound sediments database. This reliability is the fundamental concern in using chemical disposal guidelines for dredged material management; to ensure that unacceptable adverse effects due to disposal are avoided. Reliability of the sediment quality values was assessed by applying the chemical values to the existing database for Puget Sound sediments and determining the performance of the values.

Reliability testing conducted during the PSDDA Phase I studies found that the values developed using the Apparent Effects Threshhold (AET) approach (see EPTA for further description) were the most reliable values available at this time. It was also agreed that no single set of chemical values (one for each chemical of concern) was both adequately sensitive (to identify all toxic sediments) and efficient (to ensure that only toxic sediments were identified). For this reason, environmental protection was embodied in a set of lower values (screening levels, discussed below), while cost efficiency concerns were expressed in a set of higher values (maximum levels, see below). This separation of management needs (not relying on a single set of values) provides substantial additional assurance that the objectives of dredged material management can be met.

The reliability of the PSDDA chemical guideline values has been tested on the Puget Sound database and on several case projects. The lower values have been shown to be environmentally sensitive and the higher values have been shown to be cost effective. It is this reliability that justifies the use of the chemical disposal guideline values in Puget Sound regulatory applications at this time.

The PSDDA evaluation procedures suggest two levels of chemical concentrations be considered when interpreting chemical tests. First, a lower "screening level" (SL) has been defined for each chemical as a guideline to identify chemical concentrations below which there is no reason to believe that dredged material disposal would result in unacceptable adverse effects. For dredged material with chemical concentrations below the screening level values, biological testing is not required to determine material suitability for unconfined, open-water disposal. Second, a higher "maximum level" (ML) has been defined for each chemical which corresponds to the concentration of a chemical in dredged material above which there is reason to believe that the material would be unacceptable for unconfined, open-water disposal. The ML acts as the upper limit of chemical concentration for which the standard biological tests are a sufficient basis of regulatory decisionmaking.

When dredged material chemicals of concern exceed the ML values, the dredger has two options. First, he may elect to accept the indication of the ML that the material is unacceptable for unconfined, open-water disposal. Biological testing is not required for this decision. However, it is recognized that chemical levels in dredged material provide a relatively indirect measurement of possible adverse biological effects, as several factors can influence the bioavailability of these chemicals (e.g., sediment grain size, presence of organic carbon, etc.). This is why the dredger will have a second option to conduct biological testing rather than rely on the indications of the chemical maximum level. For this option, the dredger would conduct both the standard bioassays (four acute bioassays and bivalve bioaccumulation) and other additional, more sensitive sublethal tests in order to determine final biological suitability of the material for unconfined, open-water disposal. Appropriate biological tests and test interpretation would be determined by the Corps, EPA, and Ecology on a project-by-project basis. If the project material meets the test interpretation requirements, the dredged material will be considered suitable for unconfined, open-water disposal.

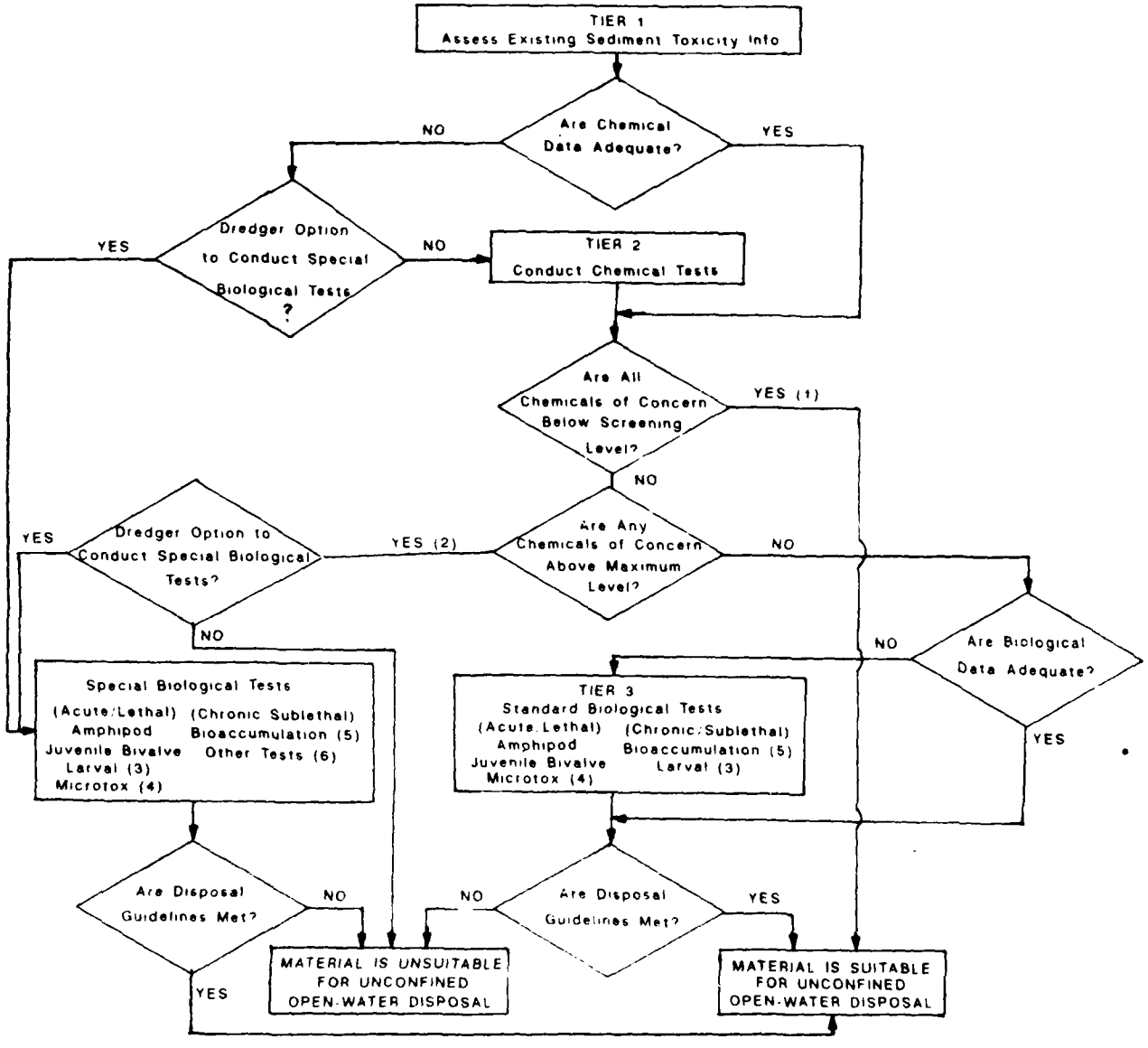
For dredging projects involving dredged material with high concentrations of chemicals of concern, the dredger may opt to proceed directly to biological testing rather than conduct chemical tests. If adequate chemical test data were not available for the project, it would be assumed that the material contained chemical levels exceeding the ML values, and that it warranted special biological testing (both standard and other, sublethal biological tests; i.e., the "dredger option" in figure 5.2), analyzing for all human health chemicals of concern in the bioaccumulation test.

If dredged material exceeding the ML values is found to be acceptable for unconfined, open-water disposal based on special biological testing, then this material may be allowed to be disposed at a PSDDA disposal site or other appropriate location. However, PSDDA agencies will need to be satisfied that such disposal does not complicate monitoring of the PSDDA site nor produce other problems. For these projects, locating an appropriate site and determining site use requirements and disposal site monitoring needs, will be addressed on a case-by-case basis. Any needed identification and designation of special unconfined, open-water disposal sites would be the responsibility of the dredger.

Unconfined, open-water disposal of dredged material with chemicals exceeding the ML values is generally considered to be outside of the scope of the PSDDA study and sites, and will necessarily be considered on a project-by-project basis (as required by the CWA). Overall, unconfined, open-water disposal of highly contaminated sediments in Puget Sound waters is not likely to occur.

5.5 Dredged Material Evaluation Procedures. This section describes in more detail the PSDDA dredged material evaluation procedures, including sampling and chemical and biological tests. Because the procedures contain several features that have not received full implementation in a regulatory program prior to PSDDA, annual reviews of the evaluation procedures will be undertaken once PSDDA is initiated. Based on these annual reviews, evaluation procedures will be modified as appropriate.

The evaluation procedures follow the testing sequence outlined in figure 5.2. The first step (tier 1) in the technical evaluation of dredged material is to determine whether there is a "reason to believe" that sediments to be removed from the project area contain chemicals of concern, and whether or not these chemicals are at concentrations that could possibly result in unacceptable sediment toxicity or water column effects. The evaluation at this first tier includes review of any existing chemical data for the project area and information on potential sources of chemicals (both historic and present) that may have resulted in chemical loading of the sediments. If there is sufficient data to indicate that there is no reason to believe that the sediments to be dredged from the project area contain chemicals of concern, then the material can be considered suitable for unconfined, open-water disposal without further testing.



(1) Biological testing may still be required if there is reason to believe that the sediment is highly anomalous and may represent a significant environmental risk even though all chemicals of concern are below screening levels for unconfined open-water disposal.

(2) Standard tier 3 biological testing can still be conducted when only a single chemical of concern exceeds the maximum level by < 100% Biological testing of material with chemical levels above maximum level is allowed as an option of the dredger(see footnote 6)

(3) The larval species can be used in either a sediment toxicity bioassy (for Section 401) and/or in a water column bioassy (for Section 404) The sediment larval test is required whenever biological testing is necessary, the water column larval test is only required when water column effects are of concern

(4) Microtox testing is required only for Section 401 reviews; it is not required for Section 404 evaluations.

(5) The chemical screening level that determines when bioaccumulaton testing is required is higher than for other biological testing

(6) Special biological testing under the "Dredger Option" will include additional, more sensitive sublethal biological tests (see EPTA).

Figure 5.2 PSDDA testing sequence.

If there is reason to believe that material from a proposed project contains sufficient chemicals of concern to warrant testing (or existing data are inadequate), then chemical testing of samples from the project area would be conducted (tier 2). The results of the tests for chemicals of concern are used to determine if there is reason to believe (using the screening level (SL) as a guideline) that the chemical concentrations are high enough to warrant biological testing (tier 3).

The recommended test procedures are further described in the section below. The disposal guidelines (test interpretation) are contained in exhibit A.

5.5.1 Review of Available Data on the Project Area (Tier 1). An initial assessment of existing data is called for in the Section 404(b)(1) Guidelines to determine if there is a reason to believe that material in the proposed project contains chemicals of concern, and whether chemicals are at concentrations that could result in unacceptable adverse effects. As part of this determination, a review is made of pertinent data available for the project area. This review includes information supplied by the dredger[1/] and information developed by PSDDA about the general dredging areas in Puget Sound.

Where records are complete, or where available data can be used to reach a decision, testing would not be required. However, to determine adequacy of existing data, the presence and concentration of the chemicals of concern must be generally known from sediment sampling and testing in the project area that was recent, representative, and of acceptable quality according to general PSDDA guidelines. Due to lack of adequate information, dredgers for many near-term projects will need to collect some sediment for chemical analysis to provide the basic information required for the project. This testing is not necessary if a sample has been taken at or adjacent to the project site that is sufficiently complete and recent enough to be considered representative.

A minimum of one sediment chemical analysis is recommended for all project areas. This sample will serve as a "safety net" in that it avoids "surprises," relaxes the need for extensive data searches, and provides sediment-specific data for use in management of the disposal site.

The list of chemicals of concern developed by PSDDA agencies should be specifically reviewed during the intitial project assessment. If available data show that certain chemicals are not present in the project vicinity, these chemicals need not be included in any further testing. Where such data is not available, the "safety net" test of a composite sample can provide the necessary information on which chemicals of concern are present, for both the current and near-future projects.

In order to facilitate the review of available project data, and to determine sampling and testing requirements (if applicable), dredging areas in central Puget Sound have been assigned a ranking based on the potential for contamination in the area, using existing information. The ranking of a dredging

1/See Glossary for difference between dredger and dredging contractor.

Minimum sampling and analysis guidelines for dredged material evaluation were defined. The guidelines specify a maximum volume of dredged material that can be represented by a single sample and by a single analysis. They are considered "minimum" guidelines in that the dredger may opt for, or regulatory agencies may require, additional samples or analyses if warranted.

In determining the number of analyses (e.g., chemical and biological tests) that would be required for characterization of project sediments, the concept of "dredged material management units" was used. A management unit is the smallest volume of dredged material for which a separate disposal decision can be made. Thus, a given volume of sediment can only be considered a management unit if it is capable of being dredged and managed separately from all other sediment in the project. This requires that management unit volumes be defined relative to dredging. Cut depths, shoal locations, and lifts all should be considered in the final description of a management unit. Therefore, the decision on suitability or unsuitability of the material for unconfined, open-water disposal is made on individual management units independently of other management units within the project.

In most cases, several samples will be composited to provide the material for a single analysis. This ensures that the material be used for each analysis is representative of the volume of material associated with the management unit.

When taking a core, the coring depth will extend 1 foot beyond the project overdepth. This 1-foot sample will be collected and archived for possible and analysis to evaluate the chemical concentration in sediments that will exposed to the water column after dredging. The potential need for this analysis is discussed in EPTA.

See paragraph 5.6.3 for a discussion of limited sampling and analysis that may be undertaken by a dredger for partial characterization of project sediments in order to achieve a lower ranking for purposes of reducing the requirements of full characterization.

5.5.5 Chemical Tests. Chemical testing will be required on each composited sample that is collected for analysis (tier 2 of testing strategy). Chemical analyses include both the measurement of conventional parameters and the measurement of concentrations of chemicals which have been identified as being of concern in dredged material because of the potential for biological impact.

Conventional parameters are required to be collected to further characterize the sediment in the management unit and to provide information to aid in interpreting chemical and biological tests. These parameters do not have interpretation guidelines and will not generally have a direct bearing on a disposal decision for the management unit. As a component of the recommended evaluation procedures, conventionals that will be measured include total volatile solids, sediment grain size distribution, total organic carbon, percent solids, manganese and ammonia. See EPTA for a discussion of the use of data from measurement of conventionals.

Chemical testing, when required, will generally involve analysis of the sediment composite sample for as many as 58 chemicals of concern (see exhibit A). The list of chemicals of concern for dredged material was developed by PSDDA based on a review of chemicals discharged into Puget Sound, and is pertinent to both Section 404 and Section 401 requirements. In addition to the Sound-wide chemicals of concern, there is a more limited list of chemicals of concern that need to be considered in projects located near specific pollution sources.

5.5.6 Chemical Disposal Guidelines. In Puget Sound, interpretation of chemical tests will be the same for both Section 404 and Section 401 assessments. As stated in section 5.4.2, concentrations of each chemical of concern found in the sediment sample will be compared to two chemical guideline values to identify the need for further testing (biological) of the sediment prior to determination of the suitability of the dredged material associated with the management unit for unconfined, open-water disposal. A lower screening level (SL) value has been specified for each chemical as a guideline to identify chemical concentrations for which there is no reason to believe that unacceptable adverse effects could occur, and below which dredged material is considered to be suitable for unconfined, open-water disposal without the need for biological testing. A second, higher maximum level (ML) value has been specified for each chemical to identify chemical concentrations above which there is reason to believe that the the dredged material would be unacceptable for unconfined, open-water disposal (without conducting optional biological testing, see section 5.4.2). Specific chemical disposal guidelines are provided in exhibit A.

5.5.7 Biological Tests. The PSDDA biological testing recommendations have been designed to address both sediment toxicity and potential water column effects. Testing includes evaluation of acute sediment toxicity using four species (amphipods, a juvenile bivalve, oyster (or other) larvae, and bacteria (used in Microtox pursuant to Section 401 requirements). The recommended tests also allow for an evaluation of potential water column effects using a separate larval bioassay, when warranted. All of the proposed tests have been previously conducted on dredging projects within Puget Sound.

The amphipod bioassay using the species Rhepoxynius abronius (Swartz, et al., 1985) has been in use in Puget Sound to evaluate dredged material since the early 1980's. The test consists of a 10-day exposure, after which the surviving amphipods are counted. A secondary sublethal response criterion, daily emergence of the amphipods from the sediment, is not recommended for disposal decisionmaking.

Oyster larvae have been used often in the past within Puget Sound for evaluating the suitability of dredged material for unconfined, open-water disposal. Developed in the mid-1970's, the test was generally applied along with elutriate testing of the sediments proposed for dredging to evaluate water column effects. Past experience with the test in other Puget Sound dredging projects indicates that the test has proven to be an inexpensive and a relatively useful indicator of toxicity. Several research efforts have

indicated good concordance between the results of oyster larvae tests and the outcome of amphipod bioassays, indicating that it is also a reliable indicator of sediment toxicity (Long and Chapman, 1985; Williams, et al., 1986). The evaluation procedures recommended by PSDDA allow the use of the larval test for assessing general sediment toxicity (always required for biological testing pursuant to Section 401 review) and/or the potential water column effects of the dredged material disposal (required only when warranted, pursuant to Section 404 evaluations).

The juvenile bivalve test can be conducted using any one of three species of filter-feeding clams found in Puget Sound: the geoduck (Panopea generosa), the pacific oyster (Crassostrea pacifica, or the native littleneck (Prototheca staminea). Though all three are commonly consumed by humans, the preferred test species at this time is the geoduck clam. The geoduck is available in local culture and is also an important component of the benthos in Puget Sound. Further, it has been applied to two recent dredging projects and has been used to evaluate a range of Puget Sound sediment types. However, there is need for further experience with all three species before a firm recommendation can be made on the best test animal.

The Microtox test consists of exposing a species of marine bacteria, Photobacterium phosphoreum, to an extract of the dredged material and observing changes in bioluminescence. Changes in luminescence may be due to both acute toxicity in individuals within the bacterial populations and/or due to acute sublethal changes in surviving individuals. Decreased luminescence following exposure to an extract of the test sediment provides a quantitative measure of toxicity.

When required, the bioaccumulation test will be conducted on adult bivalve from the genus Macoma. The exposure duration will be 30 days after which a chemical analysis will be made of the tissue residue to determine the concentration of selected chemicals of human health concern. The bioaccumulation test will only be conducted on those dredged materials proposed for dredging in which the sediment chemistry levels are above specified guideline values established by PSDDA. Also, this test will not be required on more than one half of the analyses (composited samples) for any given project.

For most biological tests, both a control and a reference sediment will be included with each test. Sediment from designated reference bays will be used as the reference sediments in biological testing for both Section 404 and Section 401 evaluations. The primary reason for this is to provide consistency in reference test results and interpretation (both within a site over time and between different sites within the Phase I area). In addition, the reference sites provide a range of sediment grain sizes that allow a match to the dredged material grain size in the biological tests. Sediment from the reference sites may also contain small or undetected concentrations of the chemicals of concern. For dredged material with relatively coarse-grained sediments, the dredger can opt to rely solely on a control sediment (acting as both reference and control).

5.5.8 Biological Response Disposal Guidelines. The response of test organisms from the biological tests will be compared to the results of the reference sediments and tissue guidelines to determine the acceptability of the material for unconfined, open-water disposal. The interpretation of biological test results will differ slightly between the Section 404(b)(1) evaluation and the Section 401 water quality certification review. The recommended disposal guidelines, including both minor differences between Sections 404 and 401 as well as the combined "net effect," are described in exhibit A.

5.5.9 Use of Test Results in Permit Decisions. The PSDDA evaluation procedures will be applied and considered as appropriate under Sections 404 and 401 on a project-specific basis. In developing general procedures for use everywhere in Puget Sound, it was not possible to consider all individual project technical factors, or assess all the possible outcomes that might arise from the test results. Consequently, professional judgment is essential in reaching project-specific decisions, and the evaluation procedures (including the disposal guidelines) are designed to be sufficiently flexible to allow full consideration of all pertinent project factors. In applying the procedures to specific projects, if the permitting agencies depart from the technical recommendations of the disposal guidelines, the permitting agencies will document the technical rationale for this departure.

5.5.10 Consistency and Flexibility in Dredged Material Evaluation. There is a need for consistent procedures for dredged material evaluation. This consistency has been demanded by local government agencies and is required to retain public acceptance of continued disposal in waters of Puget Sound. Though consistent and "objective" evaluation procedures may somewhat reduce flexibility and reliance on best professional judgment, they are needed to achieve agreement among the various regulatory agencies and to allow the transfer of knowledge as staff change. The intent of PSDDA was to compile the consensus best judgment of professionals currently involved in dredged material management and to reflect this judgment in the dredged material evaluation procedures.

Though consistency was an important objective, flexibility must be maintained in the way the evaluation procedures and disposal guidelines are applied. When technical indications warrant, decisions different from those indicated by the guidelines will be allowed, and properly documented.

The flexibility recommended is "by exception." The guidelines are expected to apply in the majority of cases. Rather than integrating flexibility into the guideline statements (by showing ranges of values, or by using terms such as "may do"), "exceptions" to the guidelines are allowed with appropriate technical rationale and documentation, when such rationale warrants a different conclusion.

5.5.11 Review of Evaluation Procedures. Because the dredged material evaluation procedures contain features that have not previously been applied in a regulatory program, annual reviews of the evaluation procedures will be

undertaken once the procedures are implemented. In many cases during development of the procedures, there were insufficient data to fully resolve key issues, or to fully judge their impact. Consequently, the annual review process is essential for determining if appropriate adjustments are needed. All interested parties will be given an opportunity to participate in these reviews. The first annual review is expected to begin by December 1989. See chapter 9 and MPTA for further discussion of this element of the plan.

The reviews (see chapter 9) will consider the sediment quality data from disposal site environmental monitoring (see chapter 7) obtained from implementing the dredged material evaluation procedures conducted as a basis for disposal. Both environmental and cost issues will be considered. Future improvements in the ability to characterize the distribution of chemicals in different parts of the Sound, and better understanding of the relationships between specific chemical concentrations and their effects on the disposal site and overall marine environment, should result in an eventual reduction in project sampling and analysis requirements.

5.6 Cost Case Studies. Four specific projects were analyzed as case studies to compare the projected costs of dredged material sampling and testing under PSDDA to costs actually incurred meeting current guidelines (interim criteria) for the Fourmile Rock disposal site (see EPTA for details). Three of the projects were Corps maintenance dredging, while one project was for new construction by the Port of Seattle. The projects included dredging done in waterways classified as high or moderate concern areas, and ranged in size from 32,000 c.y. to 137,000 c.y. of material removed from the project area. The projects analyzed are shown in table 5.2:

TABLE 5.2

PROJECTS ANALYZED IN CASE STUDIES

Project:	Volume Dredged (cy):
Kenmore Navigation Channel Maintenance Dredging	32,000
Seattle Harbor Navigation Project Maintenance Dredging, West Waterway (Shoal removal)	83,000
Seattle Harbor Navigation Project Maintenance Dredging, Upper Turning Basin	137,000
Port of Seattle, Terminal 30 Development Dredging	135,000

Costs factored into the analyses included sediment sampling (boat, equipment, and coring costs) at the project site, and physical, chemical and biological characterization of the project material (including QA/QC costs). For all but one of the case studies, dredging and disposal costs were not included in the analyses. (These costs were analyzed separately, see EPTA, 1987.) The only exception is for the Seattle Harbor Navigation Project, Upper Turning Basin dredging, in which the effects of PSDDA evaluation procedures on total project costs were also estimated (as necessary biological testing data were available).

5.6.1 Impacts to Sampling and Testing Costs. The impact of applying PSDDA sampling and evaluation procedures to dredging projects will depend on project-specific characteristics. In one of the case studies, sampling and testing costs that would be incurred under PSDDA are higher (34 percent higher) than costs actually incurred, while in the other case studies, costs that would be incurred under PSDDA are estimated to be lower than the actual sampling and testing costs (6 to 32 percent lower). These findings are summarized in table 5.3.

Historical costs for dredged material testing, though they varied significantly from project to project, were substantially less than those experienced under the FRIC. In general, the historical trend in dredging costs has been an increasing one, with the sharpest increase occurring in about 1984 with the introduction of the FRIC. Chapter 2 summarizes available information on cost trends.

TABLE 5.3

COMPARISON OF SAMPLING AND TESTING COSTS 1/

	Sampling and Testing Costs				
Project:	Actual: (Under Fourmile Rock Interim Criteria)	Costs/ C.Y.	Estimated Under PSDDA:	Costs/ C.Y.	% Difference From Actual
Kenmore	$ 29,065	$ 0.91	$ 19,764	$ 0.62	- 32%
Seattle Harbor, West Waterway	62,128	0.75	83,212	1.00	+ 34%
Seattle Harbor, Upper Turning Basin	38,305	0.28	35,802	0.26	- 6%
Port of Seattle, Terminal 30	140,800	1.04	97,695	0.72	- 31%

1/See EPTA for details.)

Reasons for the different outcome of each project are varied. Project area ranking, project sediment chemical "quality," dredging prism, and the project-specific requirements under which the project was evaluated contributed in differing degrees to project costs for sediment collection and evaluation. In general, there was a lack of consistency as to what degree a project needed to be evaluated. The degree of sediment analysis per c.y. of material to be dredged, the number of chemicals required to be analyzed, and the types of bioassays conducted were different for each project. Under PSDDA, minimum requirements for each of these parameters would be established to provide consistent case-by-case evaluation.

5.6.2 Impacts to Overall Project Costs. The effects of the PSDDA procedures on total project costs is of prime importance in evaluating the cost impacts of PSDDA to dredging projects. Overall project costs are heavily influenced by method of disposal required for the dredged material. In general, it costs more to dispose of dredged material at a confined site than it does to dispose of the material unconfined, at an open-water disposal site. Currently in the Puget Sound region, upland disposal can cost over $40 per c.y. (at existing landfills), while open water disposal costs $2-3 per c.y. depending on how far the dredging site is from the disposal site. Therefore, the more material from a project required to be placed at confined sites, the greater the overall project costs will be.

An analysis presented in EPTA suggests that, while resulting in higher costs for dredged material evaluation (e.g., sampling and testing costs) for some projects, PSDDA will lead to lower overall project costs. The main reason for this is that more material could be disposed at unconfined sites than would be possible under the interim criteria. In the absence of PSDDA evaluation procedures, the PSIC would be used by EPA and Ecology to assess dredged material for unconfined, open-water sites. The PSIC are more restrictive than the FRIC applied to the case study projects.

Of the case studies presented here, as an example, the Seattle Harbor Navigation Project work at the upper turning basin was evaluated to determine the impact of the PSDDA evaluation procedures on project costs (e.g., costs of dredging and disposal). In this project, approximately 137,000 c.y. of material were dredged. Of this, 33,637 c.y. were placed in a confined disposal site at a cost of $191,248 ($5.69/c.y.), while the remaining volume (103,598 c.y.) was disposed at an open water site at a costs of $253,815 ($2.45/c.y.). This resulted in total project costs (for dredging and disposal) of $445,063.

Results of the chemical analysis of the project sediments indicate that under PSDDA, a maximum of about 16,800 c.y. of material would have required biological testing under PSDDA, the remainder would be suitable for unconfined, open-water disposal without biological testing. Review of the available bioasssay testing (only amphipod bioassays were conducted) data indicate that all of the material might have been allowed for disposal at the open-water site. If all the material would have been allowed for unconfined, open-water disposal, costs of dredging and disposal would have been $336,000, a potential project cost reduction of $109,000. If the 16,800 c.y. of material requiring

biological testing exceeded the disposal guidelines and would have required confined disposal, costs of dredging and disposal would have been $391,000, a potential project cost reduction of $54,000. For this particular case, these project reductions are in addition to the 6 percent reduction in sampling and testing costs estimated if PSDDA evaluation procedures and guidelines had been used.

The above cost impact analysis is considered to be a reasonable assessment of what will result from application of the PSDDA evaluation procedures as is the cost comparisons shown in the FEIS (see section 4) for the alternative site management conditions. It is accepted that with different assumptions regarding the mix and costs of confined disposal options that cost impacts of the site conditions could be much greater than shown. However, even if this were the case, the same alternative (Site Condition II) and dredged material evaluation procedures would have been selected.

5.6.3 Partial Characterization. For relatively large projects the dredger may elect to perform partial characterization of sediments contained in the proposed dredging area if the dredger is of the opinion that the area is over ranked. The partial chacterization is based on chemical analysis of a limited number of samples. If this analysis indicates that the project area has been over ranked then down ranking is possible for full characterization which may substantially reduce the overall cost of sampling and testing. Partial characterization is further described in EPTA.

CHAPTER 6. DISPOSAL SITE MANAGEMENT

6.1 Introduction. This chapter discusses the disposal site use requirements, the permit process for gaining access to the disposal sites, permit compliance inspections, and agency roles in disposal site management. Environmental monitoring is discussed in chapter 7. For a typical non-Corps dredging project, the dredger (permit applicant) must apply for permits from the Corps and the State. As DNR has obtained the local shoreline permit for disposal site use, the dredger's only shoreline permit requirement is that associated with the dredging activity. However, the dredger must obtain State Hydraulics Project Approval, water quality certification and DNR disposal site use authorization.1/ Permits, if granted, are conditioned to appropriate disposal site use requirements. Once permits have been granted the Corps, Ecology and DNR conduct inspections of dredging and disposal activities to ensure that those activities are in compliance with permit conditions.

6.2 Disposal Site Use Requirements. Unconfined, open-water disposal sites will be managed in accordance with the following general site use requirements which are discussed in more detail in the Management Plans Technical Appendix (MPTA).

6.2.1 Target Area/Disposal Zone. In order to minimize the area of disposal site bottom impact, disposal operations will be given a surface target area with a 600-foot radius. Allowing for positioning error, this results in a 900-foot-radius surface disposal zone within which all dredged material must be released. See figure 4.2 for disposal site parameters.

6.2.2 Navigational Controls. Disposal site users will be notified of navigation aids to allow them to accurately position disposal barges at each site. A study of positioning methods and subsequent discussions with site users resulted in findings that some of the current positioning methods (visual sighting and standard radar) cannot reliably achieve accurate positioning. Loran-C and variable range radar have been found to be a reliable combination for Commencement Bay and Elliott Bay, although Loran-C reception was found to be a problem in Port Gardner.

Site users said they prefer visual aids such as buoys as the easiest and most reliable positioning method. The Coast Guard was contacted about the acceptability of buoys at the three Phase I sites. The response indicated that a buoy may be possible only at Port Gardner. However, due to a potential conflict with an Indian gillnet fishery, a buoy will not be used. Separate positioning methods are recommended for each site.

In Commencement Bay, Loran-C will be the primary positioning method and coordinates of the site will be provided. Variable range radar will be the backup positioning method and radar reference points will be identified.

1/For certain non-Corps Federal projects, not all State permits may be required.

In Elliott Bay, the Coast Guard Vessel Traffic Service (VTS) will assist in positioning the disposal barges. Operators will also be given radar reference points and Loran-C coordinates to use as backups.

Positioning in Port Gardner will be by variable range radar with reference points identified by DNR.

6.2.3 Noise Controls. Disposal operations will be required to meet the State noise standard (WAC 173-60).

6.2.4 Time Restrictions. Dredging activity is generally prohibited by WDF regulations from March 15 through June 15 each year. Dredging activities could also be discouraged during other periods of the year in those areas where sensitive life stages of fish (other than salmon) or shellfish species were occurring such that dredging during these periods would have unacceptable adverse impacts. Timing concerns involve such commercially important species as Pacific herring (during their spawning/egg laying stages) and Dungeness crab (during egg incubation and juvenile development periods). Other dredging projects in unique water quality areas may have timing restrictions if these areas are considered likely to experience seasonal reductions in water quality that could be exacerbated by dredging activities. However, these restrictions often increase dredging costs or impact dredging effectiveness. Such restrictions could impact certain projects by increasing costs to the point where dredging is no longer justified. This in turn could have social and economic consequences. No other programmatic time restrictions apply to use of PSDDA disposal sites. However, concern has been expressed by several Indian tribes about potential conflicts between disposal site users and tribal fishing in those areas. Time restrictions and other conditions will be applied to individual projects as needed to prevent site-specific conflicts. However, these restrictions will be considered on a case-by-case basis and dealt with when applicants seek Section 10/404 permits. See EIS section 2 for further discussion on this issue.

6.2.5 Bottom Dump Barges. In general, only bottom dump barges will be allowed to use PSDDA disposal sites in order to minimize water quality impacts. Other types of dumping, such as direct slucing or pushing material off flattop barges, result in greater dispersion of material.

6.2.6 Debris and Floatables Removal. Dredging site inspections will be made by the Corps and Ecology to ensure that contractors are removing identifiable nonfloatable debris prior to discharge at unconfined open-water disposal sites. Floatable debris will be either removed at the dredging site or picked out of the water at the disposal site. The size of debris which must be removed will be specified in Corps 404 permits and contracts.

6.2.7 Other Conditions. While not anticipated at this time, additional project or permit-specific requirements may be specified on a case-by-case basis and imposed as a specific condition for disposal of the individual Section 404 permit, Section 401 Water Quality Certification, or DNR site use permit.

6.3 Overall Permit Process. The overall permit process for dredging and unconfined, open-water disposal is shown in figures 6-1 and 6-2. Figure 6-1 shows the process for a non-Corps applicant seeking a permit to dredge and then dispose at an unconfined, open-water site. Figure 6-2 shows the process for Corps projects. Shoreline permits for disposal site use are obtained by DNR (see 6.3.1 and 6.3.5 below).

6.3.1 Local Shoreline Management Permits. Local governments have regulatory authority over use of unconfined, open-water disposal sites through the State of Washington Shoreline Management Act (SMA). The act establishes a locally based permit system guided by local shoreline management master programs and overseen by Ecology. The SMA, adopted in 1972 by the State of Washington, resulted in a State program for the management of the State's coastal resources with attention given to the environmental, economic, and social impact of resource utilization. Section 305 of the 1972 Federal Coastal Zone Management Act (CZMA) (Public Law 92-583) provides for the development of State management programs. The local shoreline master programs are part of the State of Washington Coastal Zone Management program, originally approved in 1976 by the U.S. Department of Commerce.

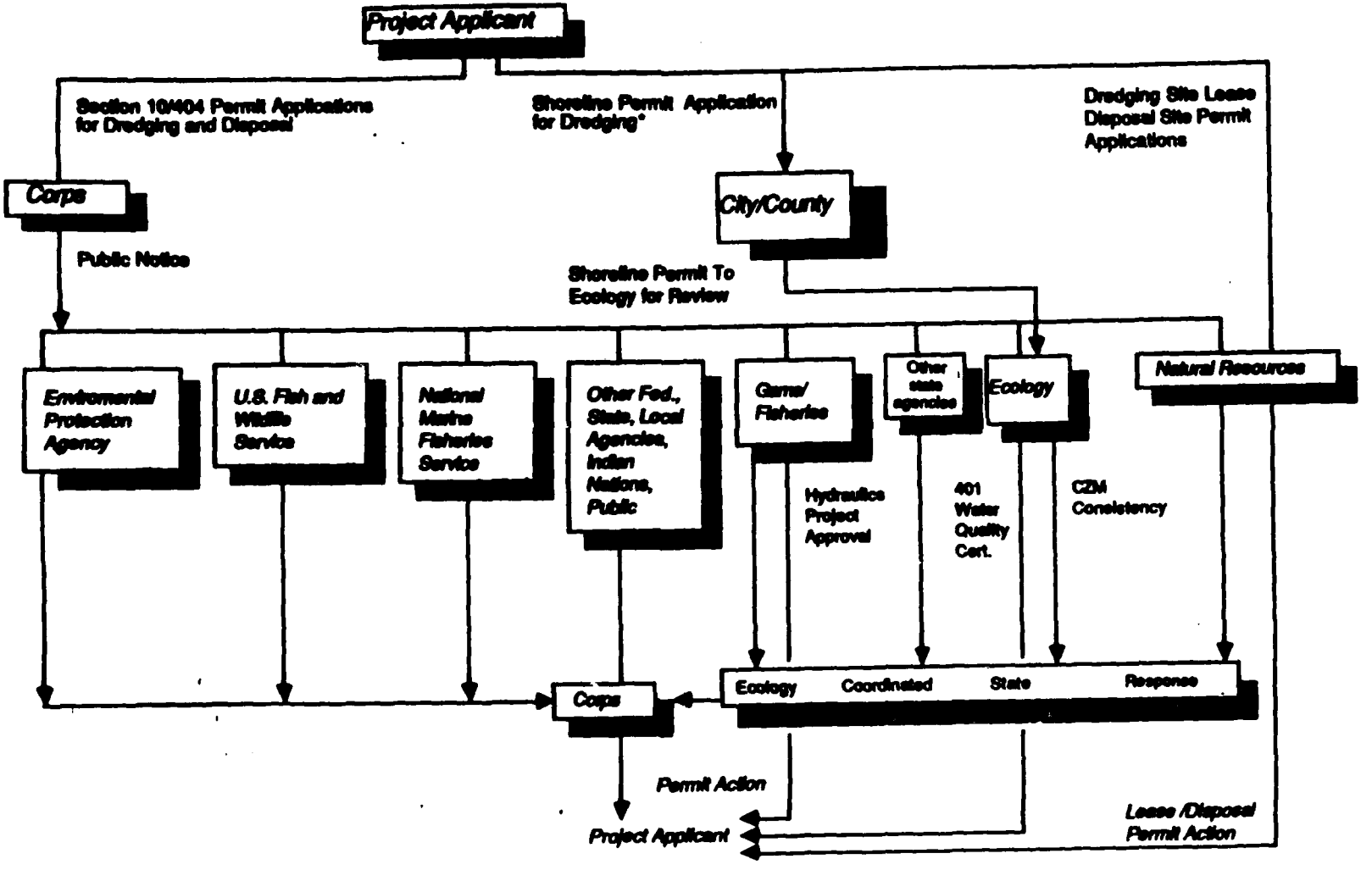
Pierce County and the cities of Seattle and Everett will use their existing shoreline management master programs to evaluate DNR's applications for shoreline permits for the proposed Phase I sites. These applications will seek permits for the maximum possible period (currently 5 years).

After reviewing all the Puget Sound master programs, the PSDDA agencies concluded that there was a need for consistency among local jurisdictions in the treatment of dredging and dredged material disposal. Accordingly, suggested model shoreline master program policies and regulations for unconfined, open-water dredged material disposal were developed in cooperation with interested shoreline jurisdictions. The model language is contained in exhibit B to this report and in exhibit D to the MPTA. The suggested master program policies and regulations have been related to the PSDDA management plan. A maximum permit period of at least 5 years is contained in the model policies and regulations which are recommended for adoption and use by each jurisdiction.

6.3.2 Section 10/404 Permit. Corps responsibility to regulate disposal of dredged or fill material in the waters of the United States is mandated by Section 404 of the CWA. The purpose of the CWA is to restore and maintain the chemical, physical, and biological integrity of waters of the United States. The Corps also regulates dredging under Section 10 of the River and Harbor Act. The review process for Section 404 and Section 10 permits is shown in figure 6-2.

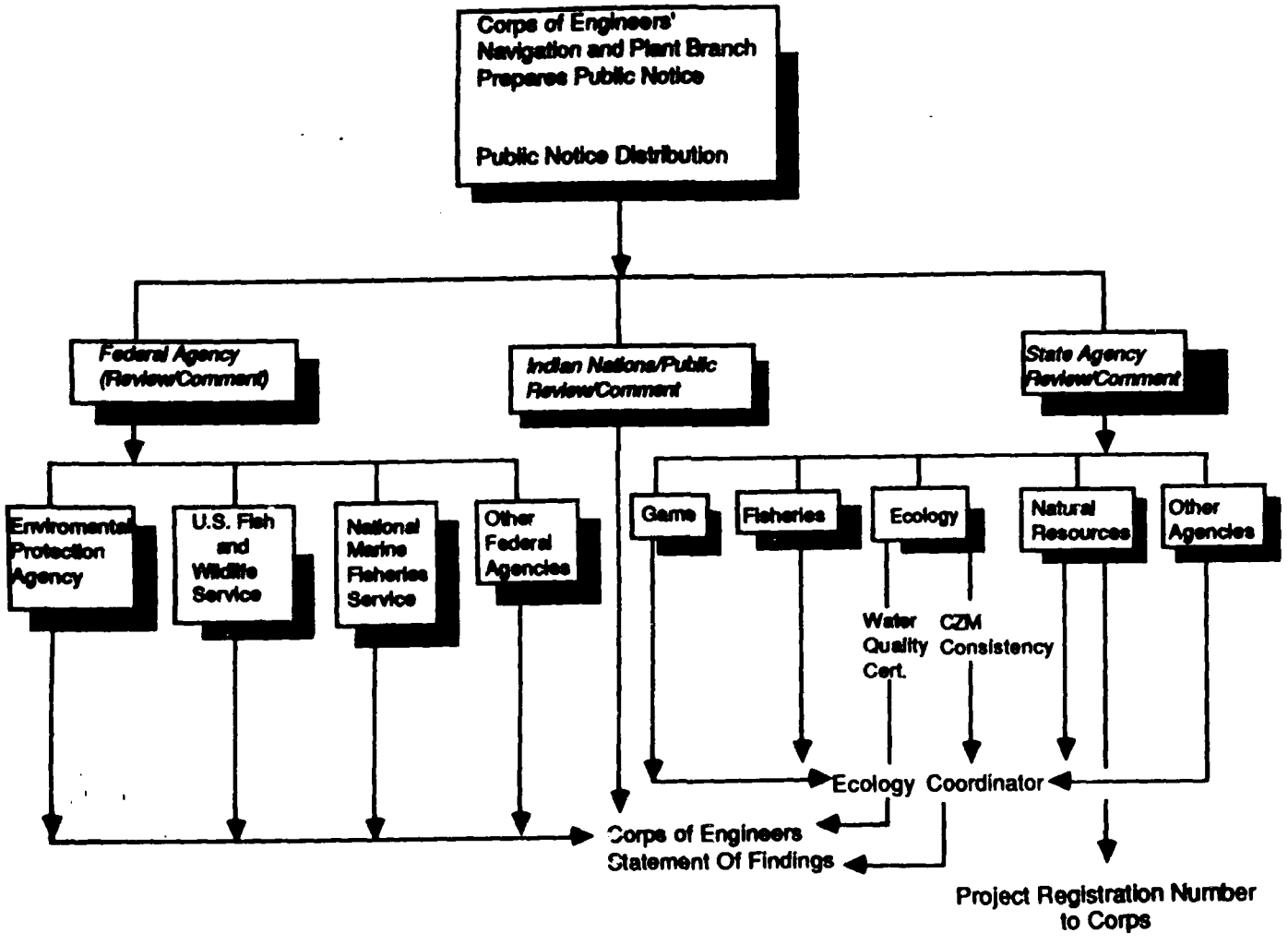
EPA, in conjunction with the Corps, develops guidelines for the implementation and use of disposal sites under Section 404(b)(1). EPA is authorized by Section 404(c), to prohibit or restrict the use of a disposal site whenever it determines that the discharge will have "unacceptable adverse impacts." EPA also reviews and comments on Section 10/404 public notices issued by the Corps.

Figure 6.1
Dredging and Disposal Permitting Process for
Non-Corps Projects



*DNR obtains permit covering all use of a disposal site.
No further shoreline permits are necessary for disposal.

Figure 6.2
Dredging and Disposal Permitting Process for Corps Projects



6.3.3 Section 401 Certification, Shoreline Management Act Oversight. Ecology has the responsibility for the State of Washington for certifying compliance with Section 401 of the CWA. This certification is required for any applicant of a Federal permit to conduct any activity which may result in any discharge into navigable waters lying within the State of Washington. The issuance of water quality certifications for non-Corps and Corps projects is shown in figures 6-1 and 6-2, respectively.

Ecology also establishes State-wide guidelines for State/local administration of the SMA. Ecology ensures that permits issued by local governments are consistent with the intent of the act. Ecology will encourage local governments to adopt the PSDDA model shoreline management master program policies and regulations. Permits issued by local governments for unconfined, open-water disposal will be reviewed by Ecology for conformance with State guidelines.

6.3.4 Hydraulics Project Approval. The Fisheries Code (RCW 75.20.100) and State regulations (WAC 220-100) establish the hydraulic project approval (HPA) process. The purpose of the HPA is to protect fish life. Through an interagency agreement with the Washington Department of Wildlife (WDW), WDF administers most HPA's in saltwater areas. The Corps Section 404 public notice, although not intended by the Corps, is accepted by WDF and WDW as the application for the HPA. The general permit process is shown in figure 6-1. Responsibility for ensuring compliance with the HPA lies with WDF.

6.3.5 Disposal Site Permit Activities of DNR. DNR is the proprietor of State-owned aquatic lands. In the past, DNR has used an established site selection procedure and issued open-water disposal permits. Sites were selected with the advice of an advisory committee, the Interagency Open-Water Disposal Site Evaluation Committee. This committee is composed of representatives of Federal and State resource agencies and meets when needed. See chapter 9 for a discussion of future agency coordination.

The DNR siting guidelines will be amended to be consistent with the PSDDA site selection process (see Disposal Site Selection Technical Appendix (DSSTA)).

DNR applied to the cities of Everett and Seattle and Pierce County for disposal site shoreline permits in January 1988 at the same time the draft EIS and other Phase I documents were released for public review. DNR is the lead agency for compliance with the State of Washington Environmental Protection Act (SEPA) requirements associated with these permits. DNR will manage all sites and ensure compliance with site use requirements. The local shoreline jurisdictions will act on the DNR applications based on the final EIS for the Phase I study area.

DNR will continue to issue dredged material disposal permits for each individual, non-Corps disposal operation. The application process is shown in figure 6-1. These permits will be granted for the term of the project but generally no longer than 2 years. This evaluation will allow DNR to adjust site use to meet revised dredged material evaluation procedures or site use requirements as they are developed. For Corps projects having local sponsors (most projects), the project sponsor will be required by DNR to obtain a DNR permit.

6.4 Compliance Inspections. PSDDA disposal sites were selected and the evaluation procedures formulated in recognition of the needs of both environmental protection and waterborne commerce. Compliance with the PSDDA plan is required to ensure that both these needs are met. This will be accomplished through spot checking of dredging and disposal site activities.

6.4.1 Methods. The dredging operation will be inspected to ensure that only suitable material is taken to the unconfined, open-water disposal sites. Predredging sediment evaluation will determine the horizontal and vertical extent of materials which are suitable for unconfined open-water disposal. A visual inspection of the site will be made to assess the potential for debris. An inspection plan will be written for each dredging operation either by the Corps for Corps projects, or by Ecology for non-Corps projects. Details of what will be contained in the inspection plans are described in MPTA. Inspections during dredging will be carried out by the Corps for both Corps and non-Corps projects; the latter to ensure compliance with Corps Section 404 permit conditions. Ecology will also conduct inspections of both Corps and non-Corps projects for compliance with their 401 Water Quality Certification. The Corps and Ecology will coordinate development of their respective inspection plans and inspections to avoid unnecessary duplication of effort. Copies of the inspection plans will be exchanged and provided to DNR.

Disposal barge positioning and other conditions of site use will be checked by both DNR and the Corps for Corps and non-Corps disposal activities. Compliance inspection at a particular disposal site will depend on the methods used for positioning at that site. At Commencement Bay and Port Gardner, inspection will be done from shore by radar. In Elliott Bay, the Coast Guard VTS system will be the primary means of checking barge position at time of disposal. Visual spot checks will also be made of disposal operations. All non-Corps disposal site users will be required to submit records of site use to DNR. The Corps will provide copies of Corps contractor inspection reports to DNR. The Coast Guard will submit records to DNR of activity reported through VTS.

6.4.2 Violation Follow-Up. Violations of permits issued for dredging and use of unconfined, open-water disposal sites may involve the dredging operation, the quality of dredged material taken to the disposal sites, positioning at the sites, or other special conditions of site use. Each agency has its own authorities for responding to violations (see MPTA). Any violations discovered by DNR, Ecology, or the Corps, through their inspection process, will be reported to the other agencies. Each agency will take appropriate action consistent with their own authorities and responsibilities.

CHAPTER 7. DISPOSAL SITE ENVIRONMENTAL MONITORING

7.1 Need For And Objectives of Monitoring. The primary function of environmental monitoring is to ensure compliance with the Section 404(b)(1) Guidelines and to field verify the PSDDA predictions of site conditions following disposal. Moreover, monitoring will provide the data to allow direct response to agency and public questions regarding site conditions and environmental impacts.

This chapter presents the key features of the overall proposed PSDDA monitoring plan. A complete discussion of the proposed environmental monitoring is contained in exhibit I of the Management Plans Technical Appendix (MPTA).

The monitoring plan is designed to address well-defined objectives or questions that directly relate to verification that unacceptable chemical and physical impacts have not resulted from dredged material disposal. These questions are:

o Does the deposited dredged material stay onsite?

o Is the biological effects condition for site management (Site Condition II) exceeded at the site due to dredged material disposal?

o Are unacceptable adverse effects, due to dredged material disposal, occurring to biological resources offsite?

Site Condition II (see sections 2 and 4 of the FEIS) will be the biological effects condition for site management at the unconfined, open-water disposal sites. By definition, Site Condition II could allow "minor effects on biological resources" at the disposal site due to chemicals of concern. This accepts some onsite sublethal or chronic biological effects. Because only acceptable sediments will be discharged at the disposal sites, the aggregate condition of each of the sites is expected to be substantially better than allowed under the selected management condition.

7.2 Scope. Given the assumption that disposal will be limited to dredged material that is consistent with site management Condition II, environmental monitoring during actual disposal operations is not considered to be necessary. In addition to supporting biological information, this decision is based on field studies that document a very small loss of fines and associated chemicals to the water column during disposal prior to impact on the bottom (see Evaluation Procedures Technical Appendix (EPTA) and Disposal Site Selection Technical Appendix (DSSTA)). Studies have also shown that conventional pollutants (e.g., sulfides, TOC, and total volatile solids) should not be a significant problem either. Consequently, water column and surface monitoring, as well as beach monitoring, will not be undertaken. Instead, the monitoring will focus on the benthic environment on or near the site. As the selected disposal sites are all located in low energy and low current areas, offsite impacts are not expected. However, offsite monitoring will be conducted to verify these expectations.

Significant numbers of mobile species are not expected to be attracted to the active disposal sites. Few species were found during field studies, although shrimp were located in the shallow portions of the Elliott Bay site. A shift of the disposal zone here, made to minimize impacts on shipwrecks, should reduce the potential for effect on this shrimp population (see FEIS exhibits C and D). Onsite benthic communities are expected to be buried to varying degrees following disposal of dredged material. Full recolonization of the disposal sites is not expected during active use of the sites since continued disposal operations will tend to cover any recolonizers. Partial recolonization will occur each year during periods when dredging operations are restricted (due to fisheries closures), however, these recolonizers would be buried once disposal operations resume. Permanent recolonization of the sites is expected once they are no longer used for the disposal of dredged material (Dexter et al. 1984; Rhoads and Germano, 1986). Prior to that time, the sites are not expected to provide sufficient prey to attract additional mobile species beyond the few that were observed during site identification studies.

The environmental monitoring element of the PSDDA management plan includes a predefined management response strategy dealing with how monitoring data are to be used and interpreted, i.e., "triggers" for appropriate management action. These actions may include additional sampling at the site ("verification sampling"), adjusting the evaluation procedures used to assess dredged material, or modifying use of the site.

Based on the questions set forth in paragraph 7.1, and utilizing accepted protocols, the monitoring plan specifies monitoring techniques, stations, and frequency for each of the selected Phase I area disposal sites. The key field analysis concepts used in the monitoring plan are: measurement of gradients, comparison to established guideline values, comparison to baseline conditions, and comparison to nearby benchmark areas. Gradient measurements assess parameters downcurrent from the site looking for evidence of offsite movement of dredged material of chemicals of concern from that material. Sediment chemical values and bioassay responses will be compared to the PSDDA guidelines to verify that Site Condition II has not been exceeded. This analysis will serve as a check of the sampling aspects of the disposal guidelines, i.e., characterization of the dredged material. Also, analysis of onsite dredged material will help provide a "field reason to believe," basis for deciding when additional site studies are necessary.

Comparison of offsite conditions to baseline conditions measured prior to disposal will be done to verify that no unacceptable changes have occurred due to dredged material disposal. Changes in parameters onsite and offsite will be compared to nearby relatively undisturbed areas (benchmark stations) to determine if changes are due to other sources or natural fluctuations.

The most intensive monitoring will occur during the first few years of site use. This will allow for early response should unexpected adverse impacts occur. Future monitoring effort may be lessened if monitoring indicates no significant effects have occurred, (i.e., PSDDA evaluation procedures are producing the expected results). Field studies will be conducted during the same

season each year (i.e., during late spring). Intensity of monitoring may differ from year to year depending on the volume of dredged material disposal during the year at the site. A tentative schedule of monitoring studies has been established for the sites, but this schedule may be adjusted if insufficient material is deposited at a site to warrant full study.

7.3 General Monitoring Plan. The general monitoring plan consists of several types of field studies, each varying in intensity and frequency, and field measurement techniques. Illustrated in table 7.1, the various categories, parameters, and techniques, and their relation to the monitoring questions, are described in following paragraphs.

7.3.1 Monitoring Categories. The monitoring plan will be accomplished in two separate steps: a baseline study before disposal takes place and periodic monitoring after disposal occurs. Table 7.2 contains the proposed schedule for baseline studies and environmental monitoring.

a. Baseline. The purpose of the baseline is to document conditions existing at and around the disposal site and at benchmark areas prior to disposal of dredged material. The information will serve as a basis for comparison of post-disposal conditions at the site, allowing an assessment of disposal impacts. Baseline data will be obtained for the same chemical, biological, and physical parameters that will be assessed during post-disposal monitoring.

Baseline studies were initiated during the spring of 1988. While biological activities occur year round at the disposal sites, spring months are normally the time of high biological activity. This is when new recruitment occurs to the benthos and demersal predators experience higher feeding rates. Accordingly, the spring is the time in which most benthic impacts can be expected and, therefore, it serves as the best period for checking site conditions. Future monitoring will always occur during this same season to allow a comparison of data for trend analysis. The monitoring activity coincides with the normal dredging closure specified by the Washington Department of Fisheries to protect outmigrating salmon and steelhead smolts (March 15 to June 15).

b. Partial Monitoring. The purpose of partial monitoring is to verify that the dredged material is staying onsite and that Site Condition II has not been exceeded. A minimum number of chemical stations will be sampled to determine chemical characteristics of the sediment. A map of the disposal area mound and spread will be produced to determine the location and direction of material movement. Both sonar and sediment vertical profiling camera (SVPC) imagery will be used. In addition, SVPC biological data will provide a general impression of biological impacts on and off site. Partial monitoring addresses two of the three key monitoring questions (see table 7.1).

TABLE 7.1

RELATIONSHIP OF KEY MONITORING QUESTIONS TO
TYPES OF MONITORING, PARAMETERS, AND TECHNIQUES
USED IN THE PHASE I ENVIRONMENTAL MONITORING PLAN

	Monitoring Questions		
	Material Stays Onsite?	Site Condition II Not Exceeded?	Biological Resources - Unaffected Offsite?
Types of Monitoring:			
Baseline	X	X	X
Partial Monitoring	X	X	
Full Monitoring	X	X	X
Parameter:			
Physical Mapping	X		
Sediment Chemistry-Onsite		X	
-Offsite	X		
Sediment Bioassay-Onsite		X	
Infaunal Tissue Chemistry			X
Infaunal Abundance			X
Techniques:			
Box Cores		X	X
Side-Scan Sonar	X		
SVPC 1/	X		

1/Sediment vertical profiling camera.

TABLE 7.2

PROPOSED SCHEDULE FOR BASELINE STUDIES AND ENVIRONMENTAL MONITORING AT EACH DISPOSAL SITE OVER A 15-YEAR MONITORING PERIOD

Year	SITES		
	Elliott Bay	Commencement Bay	Port Gardner
1988	B	B	B
1989	P 1/	P 1/	P 1/
1990	F	-	-
1991	P 2/	F	F
1992	F	-	-
1993	-	F	F
1994	-	-	-
1995	P	-	-
1996	-	-	-
1997	-	-	-
1998	-	P	P
1999	P	-	-
2000	-	-	-
2001 3/	-	-	-
2002 3/	-	-	-
2003 3/	P	P	P

B = Baseline
P = Partial
F = Full

1/The first monitoring effort after baseline will only take place after the site has been used.

2/Only physical monitoring.

3/The years 2001, 2002, and 2003 are beyond the planning horizon for PSDDA, but were used in preparing the costs of the monitoring plan for the Phase I disposal sites.

c. Full Monitoring. The purpose of full monitoring is to determine if the physical, chemical, and biological parameters, documented during the baseline study, have changed. Full monitoring frequency will vary by site and disposal volume. However, full monitoring of a disposal site will be considered after 45,000 c.y. of dredged material have been placed there.

Two full monitoring studies are felt to be necessary within the first 5 years of site use (depending on volume placed at each site) to establish whether unacceptable impacts are occurring on or off site. Full monitoring addresses all the questions discussed in paragraph 7.1 (also see table 7.1).

7.3.2 Monitoring Parameters. Three general groups of parameters will be measured during baseline and monitoring: physical, chemical, and biological. They employ different sampling tools and stations.

a. Physical. The purpose of physical measurements is to document the areal extent of the disposal impact area and subsequent material movement. This is accomplished through mapping the topography (macroscale) and microscale sediment characteristics of the site and surrounding area.

A sidescan sonar will be used, if possible, to document the macroscale topography of the site, including down current sediment movement, as well as provide some indication of small scale relief (sediment surface texture). Based on the side scan sonar imagery, SVPC stations will be used to examine the depth of disposal material on the flanks of the disposal mound relative to the site boundaries. These data will provide a quantitative indication of the location and direction of disposal material movement.

b. Chemical. Chemical monitoring stations will be sited based upon the evidence of possible material movement offsite as shown by the physical data. The purpose of chemical measurements is to document the presence of chemicals of concern on and off site due to dredged material disposal and establish if they are causing unacceptable adverse impacts. This serves as a check on the sampling and analysis of the dredging site sediments and helps to answer the questions: (a) was the dredged material properly characterized and (b) has the site management condition been met? Bioassays will be conducted at some of these stations.

c. Biological. The purpose of biological measurements is to augment chemical measurements by documenting benthic organism responses to the presence of chemicals in their environment. For the disposal site, bioassays will be used to check the site management condition. Biological tests of offsite stations will measure biological responses through bioaccumulation tests and a check of benthic infauna abundances. These responses will be compared to baseline and/or along a gradient to determine if there is an unacceptable impact from dredged material disposal.

Measurements will be made on the bioaccumulation of toxic chemicals in the body tissue of sessile benthic organisms such as worms and clams that have been exposed in the laboratory to sediments taken from the field. Bioaccumulation examines the relative exposure of these organisms to chemicals in the sediments, overlying water, and suspended particulate matter (nepheloid

layer), and the relative uptake of those chemicals. Chemical levels in tissues of benthic species have implications for the health of the measured organism, and for the degree to which the contaminant levels may affect tissue residues of predators.

d. Offsite Benchmark Stations. The purpose of offsite benchmark stations is to determine if differences in chemical and biological measurements, noted during monitoring of the disposal site, represent natural or background variation at a similar depth and substrate within the general area. In general, samples from these stations will be archived, and analyzed only if sufficient changes occur at the other monitoring stations to warrant a check of the offsite benchmark station data.

7.4 Data Analysis, Interpretation, and Response.

7.4.1 Introduction. Management of the disposal sites will be based upon analysis and interpretation of the field monitoring data, and upon subsequent agency administrative decisions. Monitoring data will be analyzed either through an evaluation based on the PSDDA dredged material disposal guidelines or a statistical comparison of the monitoring data to baseline data. Interpretation of the monitoring results, in terms of ecological significance, will require an understanding of the data evaluation procedures, and professional judgment. In addition to data analysis and interpretation, site management actions will depend on the degree of environmental risk and other considerations, e.g., feasibility.

Statistics will only be employed in the data analysis phase, solely to identify where observed differences between monitoring data (obtained subsequent to use of the site for dredged material disposal) and baseline data (obtained prior to site use) are potentially significant when considering the methods used, the variability of the parameters measures, the number of measurements made on each parameter, and the magnitude of the observed differences. Statistics consider the accuracy and precision of the monitoring methods in indicating whether the observed differences at the disposal site warrant further professional evaluation. Statistical significance does not imply ecological significance; professional judgment is essential in interpreting monitoring indications and recommending site management actions.

Statistical indicators used in data analysis are often developed by application of statistical power analysis, a widely applied environmental planning tool for considering the relationship between parameter variability, the number of samples to be taken, and the statistical confidence desired in the resulting data. The statistical triggers used in the monitoring plan are determined primarily by the variability of the parameter being measured and the work effort (number of samples) allocated by the monitoring plan. They represent minimum differences that should be observed before additional data interpretation (to consider ecological significance) is conducted.

Several study participants suggested using differences between monitoring and baseline data that were substantially smaller than those shown in the monitoring plan for determining if a condition of concern exists. However, the power

analysis indicated that these smaller differences would not be possible to measure without substantially more samples and analysis or significantly reducing the desired confidence level (see MPTA). Consequently, the study participants agreed that the statistically derived differences were the best possible, given the current level of monitoring effort proposed.

7.4.2 Data Analysis. Onsite monitoring will be limited to verification that the site management condition II has not been exceeded. This will be done through analysis of onsite sediment chemical concentrations and bioassays. If the site management condition is being exceeded, then disposal guideline adjustments will be considered.

Analysis of the monitoring data for offsite checking and development of a management response to the findings is a more complex process that includes both statistical procedures and professional review of the data. Each step in the three-step process can be posed as a question that must be addressed before moving to the next step in the decisionmaking process. The answer to each question determines whether further evaluation of the monitoring data is required. The question associated with each of the decisionmaking steps is:

Step 1: Are the values for the parameters measured during monitoring different from the values found during the baseline?

Step 2: If differences (or exceedances) are found, are they due to the disposal of dredged material or due to other causes (changes due to other chemical sources or due to natural variation)?

Step 3: If the differences (or exceedances) are due to the disposal of dredged material, what type of management action is warranted based on an assessment of the ecological impact associated with the changed conditions?

The first step in the process would be to determine whether the values observed during the monitoring effort (partial or full monitoring) differ from the values found during the baseline (step 1 in the site management process). Depending on the parameter being evaluated, one of several methods would be used to determine if the monitoring data are different from the baseline values. Sediment chemistry and SVPC data used to determine if the dredged material has spread beyond the disposal site would be compared to data on sediment characteristics gathered during the baseline for stations at the site perimeter line located approximately 1/8 of a mile beyond the site boundary.

Offsite chemical concentrations and bioassay results at other stations would be compared to baseline values for sediment chemical concentrations and toxicity (bioassays). Data on benthic body burdens and benthic abundance would be statistically compared to the baseline data to determine if differences between the data are supported. The interpretation guidelines for all of these comparisons is presented in the MPTA exhibit I.

If comparison of the monitoring data to the baseline data does not indicate that any offsite changes have occurred since disposal activity began, then it can be reasonably assumed that dredged material discharged at the disposal sites is staying onsite. However, if any of the data are found to differ from the baseline values then a question arises as to whether the differences observed are due to dredged material disposal or due to other factors affecting the disposal site area (step 2 in the site management process). Exhibit I of MPTA describes how this question will be addressed.

7.4.3 Response. If the changes observed in the vicinity of the disposal site are concluded not to be due to disposal of dredged material, then no management action would be required. If, however, analyses of the data suggests that changes around the disposal site may be due to dredged material disposal, then best professional judgment would be applied in evaluating the ecological significance of the observed changes (step 3 in the site management process). The variety of management actions that might be appropriate at this time could include (in order of increasing significance):

- o analysis of the remaining archived samples for the other monitoring parameters to determine the extent and the ecological significance of the changes;

- o offsite investigations to verify the presence of dredged material and to determine the extent and ecological significance of the effects;

- o program adjustments, such as modification of site use or amendment of disposal guidelines to bring the site management into CWA requirements of not allowing unacceptable adverse impacts; and

- o major program responses such as site relocation or mitigation at the existing site.

Any action, however, must be based on a careful evaluation by all the PSDDA agencies of the monitoring results and an interpretation of these findings relative to potential ecological significance.

7.5 Application of Dilution (Mixing) Zones. The State Water Pollution Control Act (RCW 90.48) enunciates the policies, authorities, scope, and enforcement programs to protect waters of the State. Provisions of the act allow for promulgation of rules and regulations relating to standards of water quality and for substances discharged therein, including sediments.

The State water quality standards (WAC 173-201) provide for dilution (mixing) zones when the standards cannot be met. For purposes of compliance with the State water quality standards, the dilution zone of each PSDDA disposal site will include the site itself and the adjacent area out to the perimeter line used in environmental monitoring. The State water quality certification (Section 401) and/or modifications (WAC 173-201-035), for each project granted a permit for disposal at at PSDDA site, will contain standard language

describing the dilution zone. Site Condition II is considered to be consistent with the State Water Quality Standards and the proposed disposal site dilution zones.

7.6 Agency Responsibilities, Costs, and Funding. Baseline monitoring will be conducted by Ecology with $450,000 appropriated from the State general fund for this purpose. The Corps and DNR will be jointly responsible for subsequent environmental monitoring. Monitoring studies will be coordinated to minimize costs, assure proper temporal sequencing, and data compatibility. Environmental monitoring reports produced by the Corps and DNR will be exchanged and provided to EPA and Ecology for technical review. From these reports, Ecology will prepare a summary report that will be the basis for the periodic review by the PSDDA agencies, affected local governments, and other interested parties of disposal site monitoring (see chapter 9).

The Corps will generally be responsible for the costs of physical monitoring, currently estimated at $191,600 for the 15-year period. DNR will generally be responsible for conducting chemical and biological monitoring, the cost of which is currently estimated at $1,435,800 for the 15-year period. Current projections of environmental monitoring costs by year are shown in table 7.3. Funding of environmental monitoring is discussed in chapter 9. Baseline studies and subsequent monitoring will be accomplished within available funds.

TABLE 7.3

PROJECTED ENVIRONMENTAL MONITORING COSTS

Year	Physical Monitoring (Corps)	Bio/Chemical Monitoring (DNR)	Total Projected Costs
1989	$27,400	$147,500	$174,900
1990	15,500	159,700	175,200
1991	32,100	314,000	346,100
1992	15,500	159,700	175,200
1993	26,200	315,200	341,400
1994			
1995	10,700	47,700	58,400
1996			
1997			
1998	21,400	98,300	119,700
1999	10,700	47,700	58,400
2000			
2001			
2002			
2003	32,100	146,000	178,100
TOTAL	$191,600	$1,435,800	$1,627,400

CHAPTER 8. DREDGED MATERIAL DATA MANAGEMENT

8.1 Introduction. This chapter describes how data, collected in implementing the PSDDA management plan, will be managed through an overall data management system. Data on sediment quality are currently collected and stored through a variety of mediums from elaborate computer systems to simple paper files. Several major studies have utilized microcomputer systems, while sediment data from everyday processing of dredging project permit applications are assembled in paper files.

The PSDDA study has generated considerable data in developing sediment evaluation procedures and the extensive gathering of biological and physical data on preferred and alternative disposal sites. Implementation of the PSDDA plan will produce much more data and a requirement for immediate data analysis. This further supports the need for an overall dredged material data management system. It is the intention of the PSDDA agencies that data be collected and stored in a format that is useful to as many users as possible, with the data easily accessible to all interested parties.

An annual review will be conducted by the PSDDA agencies and other interested parties of all elements of the management plan based on the environmental monitoring data collected for each of the selected public multiuser unconfined, open-water disposal sites, and the data generated from implementation of the dredged material evaluation procedures. Consideration will be given to costs and environmental effects associated with the plan as well as new findings resulting from nationwide and Puget Sound research. The intent is to ensure appropriate management adjustments are made on a timely basis, consistent with adequate supporting information and sound scientific considerations (see chapter 9 for further discussion of the annual review and update of the PSDDA plan).

8.2 Data Management Objectives. Some of the data resulting from the PSDDA program will be immediately analyzed with the results used in administrative decisions. This includes sediment test results and environmental monitoring. Other data, such as disposal site use logs, will be stored for documentation or later long-term evaluations. The objectives of data management are to: (a) facilitate the PSDDA management plan and (b) provide the means for anuual review and update of the plan.

As regulatory agencies and project sponsors are interested in the costs associated with dredged material evaluations, permit applicants may be asked to also provide information on sampling and testing costs incurred. This cost data could then become part of the overall data management program and be readily considered during annual program reviews.

8.3 Dredged Material Test Data. Dredged material sediment test data, obtained by the Corps for Section 10 and 404 permit applications and by Ecology for Section 401 water quality certifications, will be maintained by the Corps on a computer system. Cost data on sampling and testing will also

be collected and maintained on the system. The Corps will prepare an annual report summarizing data for dredged material tested over the previous dredging year (which ends on March 15). Sediment quality data from environmental monitoring of the disposal sites will also be maintained on the Corps computer system. See paragraph 8.6 for related sediment quality data management activities by Ecology.

8.4 Dredging and Disposal Permit Compliance Data. Dredging site inspection plans and permit (DNR and Corps) compliance findings collected by Ecology and the Corps during dredging site inspections will be sent to DNR as they are developed. DNR will store these data in a hard copy file along with disposal site use permit compliance findings obtained by DNR and the Corps. Compliance findings and operational status will be stored by DNR on a personal computer for active projects. DNR will provide an annual permit compliance report to the relevant local jurisdictions, other PSDDA agencies, and other interested parties.

8.5 Environmental Monitoring. DNR and the Corps will share environmental monitoring responsibilities in recognition of each agency's defined regulatory responsibilities and requirements under the CWA. DNR will be generally responsible for biological and chemical monitoring, and providing that data to the Corps for input to the PSDDA data management system. The Corps will be generally responsible for physical monitoring, including the collection and analysis of physical data and inputing these data to the PSDDA system.

The environmental monitoring data will be maintained in a computerized system which allows statistical manipulation of the data for trend analysis. Technical reports will be prepared by the Corps and DNR for their respective monitoring activities, for each disposal site, within 2 months after field data have been collected and laboratory work completed. These reports will summarize the field data, analyze the significance of the data in relation to the monitoring objectives and draw tentative conclusions as to whether or not the data suggest a basis for concern based on ecological significance. Copies of the reports will be provided for technical review to the other PSDDA agencies. Ecology will prepare an environmental monitoring summary report based on the Corps and DNR technical reports. The summary report will be part of the annual review of the PSDDA plan with copies of this report made available to the PSDDA agencies and other interested parties, e.g., Puget Sound Indian tribes, ports, local shoreline jurisdictions, etc. (see chapter 9).

8.6 Data Management System. The Corps will be responsible for developing and maintaining the computerized information management system for the data described in paragraphs 8.3 and 8.5 above. The other PSDDA agencies will have access to this system. To ensure greatest possible utility, the system will be planned on a cooperative basis through a PSDDA agency representative data management working group. A separate interagency agreement or other document will set forth (a) the scope of the system, (b) quality assurance (QA) requirements for data entered into the system, (c) data input and output formats, (d) responsibilities for data analysis, (e) system accessibility, (f) agency responsibilities, and (g) other appropriate aspects of concern to the PSDDA agencies.

The Corps PSDDA database system will be real time, accessible to the other PSDDA agencies, and in a format compatible with Ecology's data management system and, to the extent feasible, also compatible with the Puget Sound Water Quality Authority's (PSWQA) system. The Corps will perform a QA check of all sediment test data resulting from project evaluations prior to entering these data into the PSDDA data management system. Stored PSDDA sediment test data will be provided to Ecology for updating sediment quality values used to compute the Apparent Effects Threshold (AET) values which are employed in setting the screening level (SL) and maximum level (ML) values for the PSDDA evaluation procedures (see chapter 5 and exhibit A, and the Evaluation Procedures Technical Appendix (EPTA) section II). Ecology may also use other Puget Sound sediment data that meets QA checks for updating the AET values, including that resulting from the Puget Sound Ambient Monitoring Program (PSAMP) and other programs. As part of this update, Ecology will assess the need for changes in the sediment quality values used in the PSDDA evaluation procedures and present this assessment along with supporting data and analysis to the other PSDDA agencies as part of the annual review of the PSDDA plan.

CHAPTER 9. PSDDA IMPLEMENTATION

9.1 General Requirements. Individual and cooperative actions will be required by the Corps, EPA, DNR, Ecology, local governments, and others to implement the PSDDA managment plan. Many aspects of the plan relate to individual actions under Sections 404 and 401 of the Clean Water Act. Some of these aspects, particularly dredged material testing, test interpretation, and determination of acceptability for unconfined, open-water disposal, are highly technical and complex and, therefore, require considerable expertise for proper evaluation. Accordingly, technical expertise, required for project analysis, will be contributed by each of the regulatory agencies and the annual reviews of the dredged material evaluation procedures will be a cooperative undertaking by all four PSDDA agencies.

Close coordination will be necessary to implement the PSDDA plan. New scientific information is continually being developed on Puget Sound water and sediment quality, on the toxicity of various chemicals of concern, and on appropriate testing protocols. These facts, along with the recognition that agency personnel changes will occur, require established communications procedures. Dredged material management activities needing interagency coordination include the following:

o Review and processing of permit applications for dredging and dredged material disposal.

o Application of dredged material evaluation procedures to determine testing and test interpretation for specific projects.

o Consideration of adjustments in dredged material evaluation procedures.

o Use of public multiuser unconfined, open-water disposal sites.

o Environmental monitoring and consideration of adjustments to disposal site environmental monitoring.

o Consideration of new disposal sites and/or changes in existing site locations or boundaries.

9.2 Roles and Responsibilities. The various roles and responsibilities of each of the four PSDDA agencies, for implementation of the management plan, are discussed in the following paragraphs. Implementation is predicated, where appropriate, on the availability of required funds.

9.2.1 Corps of Engineers. The Corps will:

a. Consider, in conjunction with EPA, PSDDA sediment evaluation procedures, including disposal guidelines, in specifying dredged material sampling and testing requirements for Section 404 permits.

b. Cooperate with EPA and Ecology when processing applications for Section 404 permits.

c. Provide Section 404(b)(1) dredged material evaluation reports on Corps dredging projects to Ecology and EPA prior to making disposal decisions.

d. Develop a dredging and disposal operation inspection plan (see MPTA), for each Corps dredging and disposal project and provide a copy to Ecology and DNR prior to initiation of dredging.

e. Comply with all appropriate disposal site use requirements (see chapter 6) when the disposal site is being used for Corps dredging projects.

f. Inspect each Corps and Corps permitted dredging and disposal project in a similar manner as Ecology and DNR inspect non-Corps dredging and disposal projects (see MPTA).

g. Advise Ecology and DNR of any violations to the Section 404 permit by Corps and Corps permitted dredging contractors. Also advise Ecology and DNR of any actions the Corps regards as being required because of the violation(s).

h. Provide to DNR the disposal site use reports on Corps and Corps permitted dredging projects.

i. Prepare by July of each year the annual summary report on dredged material sampling and testing conducted over the previous dredging year (which ends on March 15) for Section 10 and 404 dredging and dredged material disposal project actions (permits and Corps projects (existing, and proposed that are under study)) and Section 401 water quality certifications. Reports will include data on the costs of sampling and testing. Information will be provided for each public multiuser unconfined, open-water disposal site.

j. Conduct physical environmental monitoring studies of the disposal sites and coordinate these with DNR biological and chemical environmental monitoring studies. Input the physical monitoring data to the Corps data management system. Prepare within 2 months of the completion of the monitoring studies a technical report on physical monitoring for each disposal site for that monitoring event. Relate the new monitoring data to data from previous monitoring events. Provide these reports to EPA, DNR, and Ecology for technical review. Review environmental monitoring and disposal site use reports prepared by DNR and Ecology. As part of the annual PSDDA plan review and update (see m. below) present Corps proposed disposal site management changes.

k. In conjunction with EPA, DNR, and Ecology, review the sediment quality values and biological tests used in the PSDDA dredged material evaluation procedures, and assess the need for changes in these procedures based on environmental monitoring data, other pertinent environmental information, e.g., Ecology's expanded sediment quality data management system, new research findings, etc., and cost considerations (including aspects of dredging and

dredged material disposal in addition to sampling and testing). As part of the annual PSDDA plan review and update present Corps proposed changes to the evaluation procedures.

l. Develop and maintain a centralized computer data based system for all pertinent Section 10, 404, and 401 dredged material sediment quality data and physical, chemical, and biological baseline and environmental monitoring data collected for each public multiuser unconfined, open-water disposal site. Make the data and the computer system accessible to EPA, DNR, and Ecology. The data will also be made available to others subject to request processing requirements.

m. Convene in January of each year the annual PSDDA plan review and update meeting, prepare the meeting record, and distribute by March the notification to interested parties of agreed upon changes to the plan. The Corps will implement those plan changes, if any, that are in agreement with applicable Corps policies and within its authorities, responsibilities, and funding capabilities.

9.2.2 Environmental Protection Agency. EPA will:

a. Consider, in conjunction with the Corps, PSDDA sediment evaluation procedures, including disposal guidelines, in specifying dredged material sampling and testing requirements for Section 404 permits.

b. Review the annual summary report prepared by the Corps on dredged material sampling and testing for Section 10 and 404 permits and Section 401 water quality certifications.

c. Review Section 404(b)(1) dredged material evaluations for Corps projects in cooperation with the Corps and Ecology.

d. Review Corps, DNR, and Ecology environmental monitoring and site use reports.

e. In conjunction with the Corps, DNR, and Ecology, review the sediment quality values and biological tests used in the PSDDA dredged material evaluation procedures based on the considerations identified in paragraph 9.2.1.k. above. As part of the annual PSDDA plan review and update (see g. below) present EPA proposed changes to the evaluation procedures.

f. Participate in the annual PSDDA plan review and update meetings. Implement those agreed upon plan changes, if any, that are in agreement with applicable EPA policies and are within its authorities, responsibilities, and funding capabilities.

9.2.3 Department of Natural Resources. DNR will:

a. Amend WAC 332-30-166 to be consistent with the disposal site selection and management process developed through PSDDA, including revising the fee schedule and interagency coordinating committee.

b. Notify existing disposal site permittees that their existing DNR permits will have to be amended prior to use of the preferred disposal sites.

c. Acquire local shoreline management permits for preferred unconfined, open-water disposal sites for the maximum period permissible (currently 5 years).

d. Perform disposal site user permit (DNR) compliance inspections.

e. Enter into formal agreement with the U.S. Coast Guard for continued use of the VTS (Vessel Traffic System) for verifying proper disposal barge positioning at the Elliott Bay preferred disposal site.

f. Establish variable range radar reference points for use by disposal barge operators at Commencement Bay, Elliott Bay, and Port Gardner disposal sites.

g. Establish Loran-C coordinates for use by disposal barge operators at the Commencement Bay and Elliott Bay disposal sites.

h. Continue use of the current DNR data management system for tracking disposal site use and share this information with all interested parties.

i. Review the annual summary report prepared by the Corps on dredged material sampling and testing conducted for Section 10 and 404 permits and Section 401 water quality certifications.

j. Conduct chemical and biological environmental monitoring studies of the public multiuser unconfined, open-water disposal sites and provide these data to the Corps for input to the Corps data management system. Prepare within 2 months of the completion of the monitoring studies a technical report for each disposal site for that monitoring event. Relate the new monitoring data to data from the baseline and/or previous monitoring events. As part of the annual PSDDA plan review and update (see m. below) present DNR proposed disposal site management plan changes.

k. Prepare annual site use reports and provide to PSDDA agencies, local shoreline jurisdictions, and others.

l. In conjunction with the Corps, EPA, and Ecology, review the sediment quality values and biological tests used in the PSDDA dredged material evaluation procedures based on the considerations identified in paragraph 9.2.1.k above. As part of the annual PSDDA plan review and update present DNR proposed changes to the evaluation procedures.

m. Participate in the annual PSDDA plan review and update meetings. Implement those agreed upon plan changes, if any, that are in agreement with applicable DNR policies and within its authorities, responsibilities, and funding capabilities.

9.2.4 Department of Ecology. Ecology will:

a. Adopt, through regulation or as agency guidelines, PSDDA dredged material evaluation procedures as a basis for Section 401 water quality certification determinations.

b. Conduct baseline studies at each disposal site in conformance with the PSDDA monitoring plan and transmit data to Corps for entry into Corps dredged material data management system. Provide these data to DNR for comparison with results from subsequent environmental monitoring studies.

c. Develop dredging operation inspection plan for non-Corps projects and coordinate with the Corps to assure inspection plans are similar to those for Corps projects.

d. Conduct onsite inspections of Corps (per the Corps developed inspection plans) and non-Corps dredging projects and report results to the Corps.

e. In conjunction with the Corps, EPA, and DNR, review the sediment quality values and biological tests used in the PSDDA dredged material evaluation procedures and assess the need for changes in these procedures based on the considerations identified in paragraph 9.2.1.k above. As part of the annual PSDDA plan review and update (see h. below) present Ecology proposed changes to the evaluation procedures.

f. Review DNR and Corps disposal site use and environmental monitoring technical reports.

g. Prepare within 2 months of receiving the Corps and DNR technical monitoring reports a summary report on the physical, chemical, and biological environmental monitoring studies which assesses the effectiveness of the environmental monitoring plan and the need for changes in management of the public multiuser unconfined, open-water disposal sites in accordance with the procedures contained in exhibit I to the Management Plan Technical Appendix (MPTA). Provide this report, at least 1 month prior to the annual plan review meeting, to the Corps, EPA, DNR, and other interested parties, e.g., local shoreline jurisdictions, Indian tribes, ports, etc. As part of the annual PSDDA plan review and update present Ecology proposed disposal site management changes.

h. Participate in the annual PSDDA plan review and update meetings. Implement those agreed upon plan changes, if any, that are in agreement with applicable Ecology policies and within its authorities, responsibilities, and funding capabililties.

i. Assist local governments in amending their shoreline management master programs to be consistent with PSDDA-recommended model shoreline master program elements for unconfined, open-water dredged material disposal (see exhibit B).

9.2.5 Local Shoreline Jurisdictions. The city of Seattle, the city of Everett, and Pierce County are asked to:

a. Use PSDDA program documents for reviewing disposal site shoreline permit applications submitted by DNR for the selected disposal sites.

b. Issue shoreline permits to DNR for the selected disposal sites for the maximum periods possible (currently 5 years) with an option for a 1-year extension.

c. Amend, as soon as practicable, local shoreline management master programs to be consistent with PSDDA recommended model shoreline master program elements for unconfined, open-water dredged material disposal (see exhibit B).

9.2.6 Other Interested Parties. Interested Puget Sound ports, Indian tribes, and other organizations will be given an opportunity to participate in the annual reviews of the PSDDA plan and have access to technical data/reports resulting from environmental monitoring of the permitted disposal sites.

9.3 Authorities. Basic authority and responsibility for decisions on the disposal of dredged material will rest with the Seattle District Engineer, Corps; the Region X Administrator, EPA; the Commissioner of Public Lands, Washington DNR; and the Director, Washington Ecology. Each agency will carry out its roles and responsibilities as defined in paragraph 9.2, under existing authorities.

9.4 Annual Review and Plan Update. As noted above, an annual review will be undertaken by the Corps, EPA, DNR, and Ecology of the PSDDA plan to assess impacts and the need for plan revisions based on both environmental and economic considerations. Other interested parties will be given an opportunity to participate in the reviews (see 9.2.6 above). Scientists and other dredged material experts may also be invited to participate. If these reviews establish that changes to the plan are appropriate then the changes will be made by the above agencies with all interested parties notified of the changes., All plan changes will be subject to the review of the heads of the above agencies. See MPTA Section 7.4 for additional discussion of the annual review and plan update process which is intended to promote environmental protection and cost effective management of dredged material disposal.

9.5 Program Funding. With implementation of the PSDDA plan, ongoing dredged material regulatory functions of the agencies will continue, but at expanded levels for Ecology, DNR, and the Corps.

Historically, the Corps and EPA use Federal appropriations for administering dredged material disposal permits and compliance efforts. The Corps is expected to incur a permit administration and compliance program cost increase. Ecology will experience increased costs for permit administration and will continue to fund its program from the State general fund. The major new program costs for PSDDA are for the environmental baseline and monitoring studies. The phase I environmental baseline studies, estimated to cost $450,000, have been funded by the Washington Legislature through Ecology.

Environmental monitoring responsibilities will be shared by the Corps and DNR. The Corps will be responsible for physical disposal site monitoring consistent with Federal requirements under Section 404. The cost for physical monitoring is currently estimated at $191,600 (excluding inflation) over 15 years.

DNR will be responsible for chemical and biological monitoring. These costs are currently estimated at about $1,435,800 (excluding inflation) over 15 years. DNR will cover its administration and environmental monitoring costs through a combination of general fund requests and user fees. Expenditure of State general fund money for this purpose is appropriate since most sediment contamination was caused by upland runoff and sewage discharges rather than the marine industries doing the dredging.

The 1987 legislature authorized DNR to establish fees for management of dredged material disposal. The fees are limited to the amount necessary to cover the costs of disposal site management. The legislature also appropriated $193,000 to subsidize environmental monitoring during the FY87-89 biennium and established a Dredged Material Disposal Site Use Account for fee revenues.

DNR will establish initial disposal site user fees during the first half of 1988 through the regulation adoption process which provides for public review and comment. Fees will be based on current projections of disposal volume and general fund appropriations. Based on current projections of general funds and fee revenues, it appears that initial DNR site user fees will need to be set at around $.40/cubic yard. This assumes that DNR will receive State general fund appropriations totaling $673,000 over three bienniums. If revenues and costs are as projected, DNR should be able to decrease the fees after the major monitoring efforts of the first few years. By law, fees are limited to levels necessary to cover program costs. The basis for the fees and alternative user fee/general fund funding scenarios will be fully discussed during the DNR fee adoption process. Fees will be adjusted periodically based on the availability of general fund money, actual user fee revenues and monitoring costs, and on updated projections of disposal volumes.

9.6 Economic Costs. The PSDDA plan will have an economic impact on the private sector, Puget Sound ports, and others performing dredging activities. Even though sampling, testing, and test interpretation costs are expected to rise for some projects by as much as 34 percent (see chapter 5), the overall impact is expected to be lower costs for dredged material disposal as more material is expected to be found acceptable for unconfined, open-water disposal than under the existing Puget Sound Interim Criteria (PSIC) (see chapter 2). Also, the resolution by the PSDDA study of issues associated with unconfined, openwater dredged material disposal, should reduce costly project delays.

9.7 Dispute Resolution. The Corps, EPA, DNR, and Ecology will continue to coordinate their respective activities in carrying out the PSDDA plan. Resolution of any differences regarding elements of the plan will be pursued through involvement of the four agency heads, if need be. However, each agency must carry out its responsibilities in accordance with its own authorities. There is no intention through development of the PSDDA plan that these authorities be diluted, delegated, or infringed upon.

EXHIBIT A

PSDDA DREDGED MATERIAL EVALUATION PROCEDURES

EXHIBIT A
PSDDA DREDGED MATERIAL EVALUATION PROCEDURES

TABLE OF CONTENTS

TABLES

FIGURES

EXHIBIT A

PSDDA DREDGED MATERIAL EVALUATION PROCEDURES

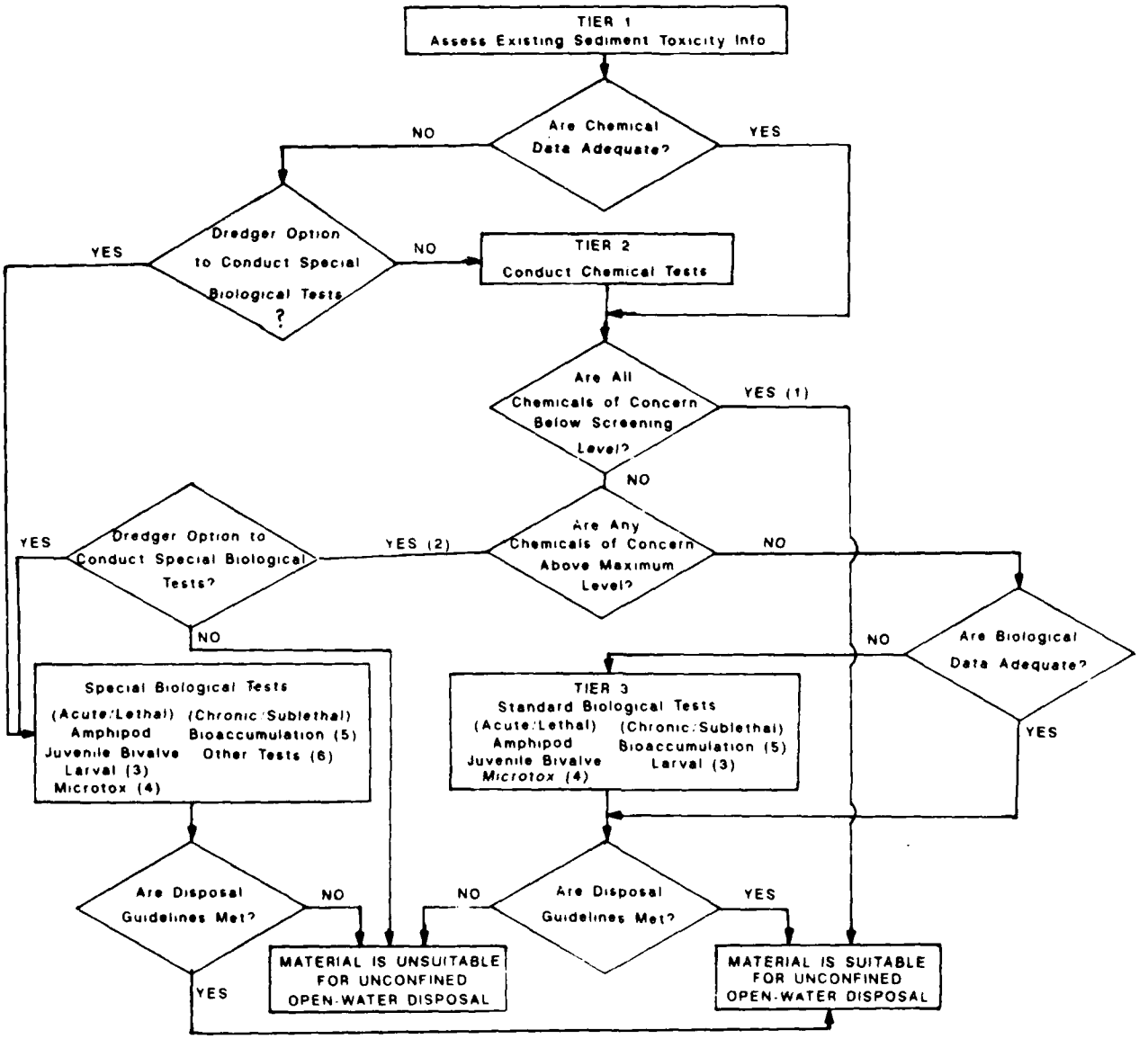
This exhibit further describes the PSDDA dredged material evaluation procedures, including sampling, chemical and biological tests, and disposal guidelines (test interpretation). In particular, sampling and analysis guidelines and chemical and biological disposal guidelines are presented. Detail beyond that contained here is provided in the Evaluation Procedures Technical Appendix (EPTA) along with the technical basis for these guidelines. A separate users manual for regulatory agencies is being prepared by Ecology. The users manual is intended to be available by the winter of 1988 for regulators and others, e.g., port planners and private consultants, for use in planning dredging projects.

A series of flow diagrams of the proposed PSDDA evaluation procedures for determining the suitability of dredged material for unconfined, open-water disposal are presented in figures A.1, A.2, and A.3. The diagrams provide a guideline for decisionmaking needed when testing dredged material for aquatic disposal. Figure A.1 outlines the overall tiers of the evaluation procedures and highlights the test sequence. Figure A.2 outlines the recommended disposal guidelines to be used in interpreting test results. Figure A.3 expands upon figure A.2 regarding specific interpretation pursuant to Section 401 reviews.

1. Review of Available Data on the Project Area. An initial assessment of existing data (tier 1) is called for in the Section 404(b)(1) Guidelines to determine if there is a reason to believe that material in the proposed project contains chemicals of concern. As part of this determination, pertinent data available for the project area are reviewed. This review includes information supplied by the dredger and information developed by PSDDA agencies about the general dredging areas in Puget Sound. Available data from past dredging projects concerning the number and proximity of chemical sources to the major dredging areas was reviewed during the PSDDA study.

Where records are complete, or where available data can be used to reach a decision, testing is not required. For the many areas where this information is not available, sediment chemical testing is needed to specifically determine if the sediment contains chemicals of concern.

A key consideration in determining whether available data are adequate for project review is the recency of the information. With older data there is increased potential for a "changed condition" that could alter its validity. Data must be sufficiently recent to be considered representative of the material to be dredged. Acceptable recency is based on the number and operating status of contaminant sources near the area to be dredged, on whether the sediment is close to the sediment-water interface, and on how well previous samples describe the current conditions at the project site. The



(1) Biological testing may still be required if there is reason to believe that the sediment is highly anomalous and may represent a significant environmental risk even though all chemicals of concern are below screening levels for unconfined open-water disposal.

(2) Standard tier 3 biological testing can still be conducted when only a single chemical of concern exceeds the maximum level by < 100% Biological testing of material with chemical levels above maximum level is allowed as an option of the dredger(see footnote 6)

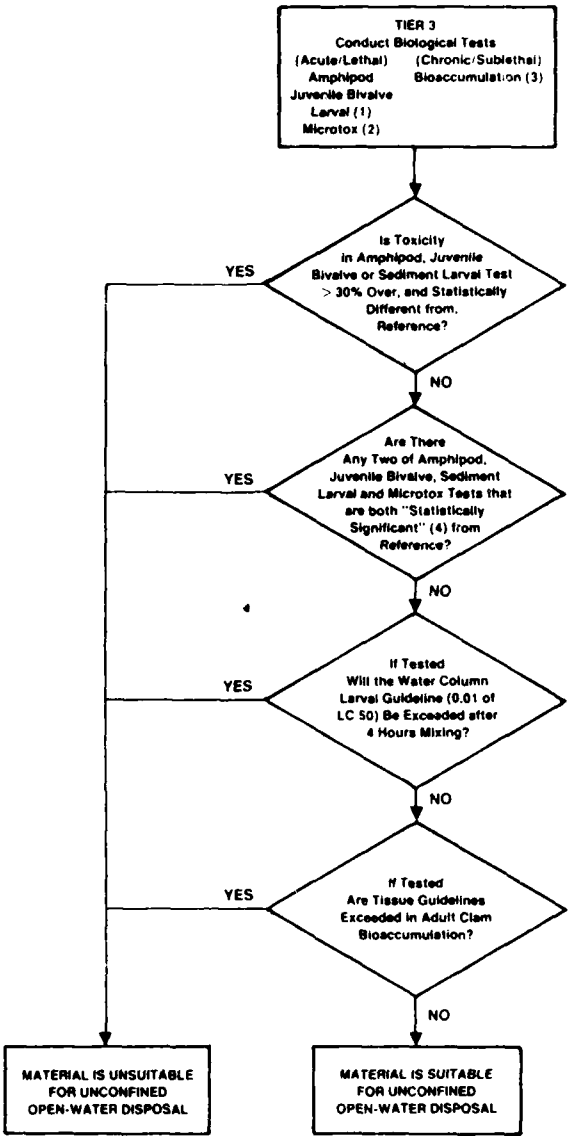
(3) The larval species can be used in either a sediment toxicity bioassy (for Section 401) and/or in a water column bioassy (for Section 404) The sediment larval test is required whenever biological testing is necessary, the water column larval test is only required when water column effects are of concern

(4) Microtox testing is required only for Section 401 reviews; it is not required for Section 404 evaluations.

(5) The chemical screening level that determines when bioaccumulaton testing is required is higher than for other biological testing.

(6) Special biological testing under the "Dredger Option" will include additional, more sensitive sublethal biolcgical tests (see EPTA).

Figure A.1. PSDDA testing sequence.



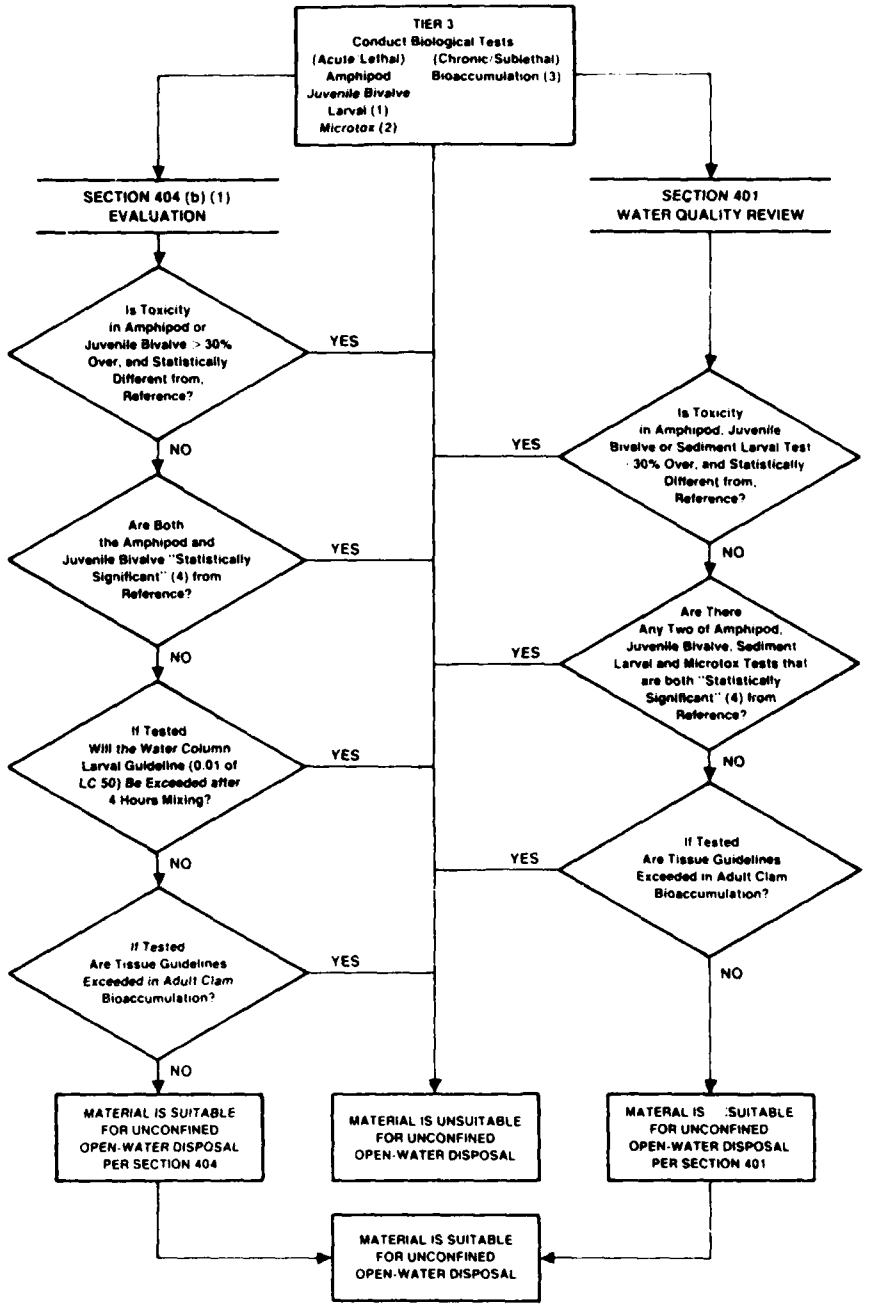
(1) The sediment toxicity larval test (for Section 401 reviews) is conducted whenever biological testing is required. The water column larval test (for Section 404 evaluations) is done only when water column effects are of concern.

(2) Microtox testing is required only for Section 401 reviews; it is not required for Section 404 evaluations.

(3) The chemical screening level that determins when bioaccumulation testing is required is higher than for other biological testing.

(4) "Statistically Significant" requires both a statistical difference from reference and total mortality response that is greater than 20 percent (absolute) over control.

Figure A.2. PSDDA disposal guidelines.



(1) The sediment larval test (for Section 401 reviews) is conducted whenever biological testing is required. The water column larval test (for Section 404 evaluations) is done only when water column effects are of concern.

(2) Microtox testing is required only for Section 401 reviews; it is not required for Section 404 evaluations.

(3) The chemical screening level that determines when bioaccumulation testing is required is higher than for other biological testing.

(4) "Statistically Significant" requires both a statistical difference from reference and total mortality response that is greater than 20 percent (absolute) over control.

Figure A.3. Section 404 and Section 401 disposal guidelines.

recency guidelines allow the use of information for the project area to be valid for a period of 2 years for dredging surface sediments in areas with ongoing, active contaminant sources. In all other areas (i.e., surface or subsurface sediments (as defined in chapter 5), and with or without sources), it is recommended that data be considered valid for a period of 5 to 7 years.

The recency guidelines do not apply when a known "changed" condition has occurred (e.g., accidental spills or new discharges have occurred since the most recent samples were obtained). These guidelines are not considered firm rules that cannot be exceeded, but are intended to assist the regulatory process.

In order to facilitate the review of available project data, and to determine sampling and testing requirements (if applicable), dredging areas in central Puget Sound have been assigned a ranking based on the potential degree of contamination that could be found in the area using existing information. Four possible rankings may be assigned to a dredging area: high, moderate, low-moderate, and low. In that order, these rankings represent a scale of decreasing concern for potential contamination and a concomittant reduction in information, sampling, and analysis requirements. The ranking system was based on two factors:

a. The number and kinds of contaminant sources (existing or historic).

b. The available information on chemical and biological response characteristics of the sediments.

Characteristics of high ranking areas include many known contaminant sources, high concentrations of chemicals, and/or significant acute toxicity in sediment bioassays. Characteristics of low ranking areas include few or no contaminant sources of contamination, low chemical concentrations (typically below a level predicted to result in significant acute toxicity), and no significant response in biological tests. Sufficient data must be available to characterize the chemical and biological variable of concern for both high and low ranking areas.

A moderate ranking is assigned to areas for which data are not available or are incomplete. When a low ranking may be indicated for an area, but the data are incomplete to confirm the ranking, a ranking of "low-moderate" is assigned. In contrast, when a high ranking is indicated for an area based upon preliminary data, the area receives a "high" ranking as a protective measure. There is no ranking of "high-moderate." All other areas are ranked "moderate." The basis for area rankings is further described in EPTA.

Initial rankings assigned in the Phase I study area of PSDDA are shown in table A.1. There are few active dredging areas in central Puget Sound that can be ranked initially as "low" or "low-moderate." Dredging in Phase I areas typically is in areas with many sources of contamination resulting in many of the areas being ranked high. Additionally, past data collection efforts focused on identifying contaminated areas. Refinement of the initial rankings is allowable within a bay, within a project, and even within a dredge cut (e.g., subsurface sediments only) based on the results of sediment-specific tests.

TABLE A.1

INITIAL AREA RANKINGS IN THE PHASE I STUDY AREA
(RELATIVE TO POTENTIAL FOR PRESENCE OF CHEMICALS OF CONCERN)

High Rankings:

- East Waterway, Everett Harbor
- Intertidal areas of Snohomish River up to upper turning basin
- Mukilteo
- Edmonds (except at Chevron tanks)
- Kenmore
- Outer Eagle Harbor (south of the creosote plant)
- Salmon Bay
- Lake Washington ship canal
- Elliott Bay
- Duwamish River (except upper turning basin)
- Sinclair Inlet
- Commencement Bay (except Milwaukee Waterway)
- Lake Union

Moderate Rankings:

- Subtidal areas of the Snohomish River (through upper turning basin)
- West Port Susan (near Cavelero Beach)
- Ferry terminals Clinton and Gedney Island
- Chevron tanks near Edmonds
- Port Madison
- Kingston ferry terminal
- Upper terminal basin of the Duwamish River
- Lake Washington (except Kenmore)
- Dyes Inlet
- Ferry terminal at Fauntleroy
- Gig Harbor
- Upper portion of Quartermaster Harbor
- Ferry terminals at Point Defiance and Vashon Island
- Milwaukee Waterway, Commencement Bay

Low-Moderate:

- Inner Eagle Harbor (west of creosote plant)
- Outer Quartermaster Harbor
- Port Orchard

To summarize, review of existing data from a proposed project includes information provided by the dredger that is specific to (or nearby) the project and information on the general project area that is embodied in the area's ranking. Due to lack of adequate past data, many projects will require chemical analysis to provide the basic information needed for the project.

Chemical or biological testing may not be required if existing data are sufficient to determine that dredged material disposal would not result in unacceptable adverse effects.

2. Small Project Exceptions. For small projects, the cost of testing must be balanced against the environmental risks posed by a very small volume of dredged material. Very small projects often provide little reason to believe that unacceptable adverse effects are possible. As a result, the proposed volume of sediment to be removed at a dredging site, if unusually small, can obviate the need for testing.

To clearly define what constitutes a small project, two key qualifiers were developed. First, intentional partitioning of a dredging project to reduce or avoid testing requirements is not acceptable. Second, recognizing that multiple small discharges can cumulatively affect the disposal site, "project volumes" are defined in as large a context as possible. One example of this latter qualifier is recurring maintenance dredging of a small marina where "project volume" would be the summed volume over the permit life (often 5 years). Another example is multiple-project dredging contracts where a single dredging contractor conducts dredging for several projects under a single contract or contract effort. Again, the "project volume" would be summed across all projects (as would any sampling and compositing efforts prior to testing).

For very small projects in low, low-moderate, or moderate ranked areas, volumes for which no testing need be conducted, are shown in table A.2. In the absence of specific, conclusive evidence of unacceptable material, projects with these or lesser volumes would be categorically considered suitable for unconfined, open-water disposal. For low ranked areas, the "no test" volume is equal to the dredged material sampling unit (i.e., 8,000 c.y.). For low-moderate and moderate rankings, the "no test" volume of 500 c.y. is representative of the capacity of smaller barges in use in Puget Sound.

For small projects (less than 500 c.y.) located in high ranked areas, some testing will be required. The dredger will have the option to conduct either a single chemical analysis for all chemicals of concern (without the required QA/QC replication), or to conduct acute bioassays (amphipod only) on a single sample (without chemistry, but with appropriate bioassay replicates). For the chemistry option, the proposed "maximum levels" would be used as "acceptable/unacceptable" values. The dredger would still have an additional option to conduct biological testing as described in chapter 5 if the material exceeded the ML values.

For small projects above the "no test" volume but less than 4,000 c.y. (except for project areas ranked low), if biological testing is needed, only a single acute bioassay (amphipod only) would be required per table A.3. For projects in low ranked areas that exceed 8,000 c.y. and require biological testing based on chemical test results, the full biological testing protocol will be

TABLE A.2

"NO TEST" VOLUMES FOR SMALL PROJECTS 1/

Area Ranking	"No Test" Volume
Low	Less than 8,000 c.y.
Low-Moderate	Less than 500 c.y.
Moderate	Less than 500 c.y.

1/Small projects that involve total volumes of dredged material less than those listed may dispose of the material at unconfined, open-water sites without testing unless specific, conclusive evidence exists demonstrating that the material is unacceptable.

TABLE A.3

REDUCED TESTING REQUIREMENTS FOR SMALL PROJECTS ABOVE "NO TEST" VOLUME 1/

Area Ranking	Volume	Required Biological Tests 2/
Low	less than 8,000 c.y.	No biological tests required
Low-Moderate	greater than 500 but less than 4,000 c.y.	Single acute bioassay (amphipod)
Moderate	greater than 500 but less than 4,000 c.y.	Single acute bioassay (amphipod)
High	greater than 500 but less than 4,000 c.y.	Single acute bioassay (amphipod)

1/"No test" volumes are defined in table A.2.
2/Chemical tests are required of all such projects. Biological tests as listed are required if chemical results indicate that the dredged material contains chemical concentrations above the screening levels.

followed. This is because low ranked areas are not expected to exceed the chemical "screening levels," which is one of the reasons why the "no test" volume was set so high relative to other area ratings.

3. Testing Tiers. When available information (per tier 1) indicates the need for further sampling and analysis, the following sequence of sediment testing would be performed. This sequence influences both sampling and testing. Tiering of tests can reduce costs by efficiently allocating resources for testing, but tiering also has the disadvantage of extending analyses over a longer period, potentially resulting in project delays and increasing other project-related costs.

Biological testing of sediment to assess potential benthic (sediment toxicity) and/or water column effects is required only when chemical concentrations are within a certain range (e.g., between the screening level and maximum level), although the option exists to biologically test sediment with chemical concentrations above the maximum level. As a result, sediment testing is conducted in two tiers, one for chemical tests and one for biological (and related) tests.

4. Sampling Requirements. The number of samples to be taken and the number of analyses conducted for characterizing any given project should be sufficient to allow for an adequate environmental assessment of a project while, at the same time, being cost-effective. Minimum sampling and analysis guidelines for dredged material evaluation were defined. The guidelines specify a maximum volume of dredged material that can be represented by a single sample and by a single analysis. They are considered "minimum" guidelines in that the dredger may opt, or regulatory agencies may require, additional samples or analyses if warranted.

The maximum volume of sediment that may be represented by a single sediment sample is presented in table A.4. Samples may be obtained by a number of different methods, including grabs and cores; and a single core (e.g., 12 feet in length) may be divided into several samples (e.g., three samples each 4 feet in length). For projects in areas ranked low or low-moderate, a single sediment sample will be taken for every 8,000 c.y. of material to be dredged above and below the 4-foot depth. For projects in areas ranked moderate or high, a single sediment sample will be taken for every 4,000 c.y. of material to be dredged.

In determining the number of analyses that would be required for characterizing project sediments, the concept of "dredged material management units" was used. A management unit is the smallest volume of dredged material for which a separate disposal decision can be made. Thus, a given volume of sediment can only be considered a management unit if it is capable of being dredged and managed separately from all other sediment in the project. Therefore, the decision on acceptability or unacceptability of material for unconfined, open-water disposal is made on individual management units independently of other management units within the project.

See MPR Chapter 5 (paragraph 5.6.3) for a discussion of limited sampling and analysis that may be undertaken by a dredger for partial characterization of project sediments in order to achieve a lower ranking for purposes of reducing the requirements of full characterization.

TABLE A.4

MINIMUM SAMPLING GUIDELINES
FOR DREDGED MATERIAL

Area Rank	Maximum Volume of Sediment Represented by Each Sample (c.y.)	
	Volume Above 4 Foot Cut Depth	Volume Below 4 Foot Cut Depth
Low	8,000	8,000
Low-Moderate	8,000	8,000
Moderate	4,000	4,000
High	4,000	4,000

Table A.5 presents the maximum volumes of sediment associated with a management unit that may be characterized by a single analysis based on area ranking and depth. For example, in a high ranking area with less than 4 feet cut depth, one analysis is required for every 4,000 c.y. of material to be dredged. In an area with a low-moderate ranking and below the 4-foot cut depth, only one analysis is required for every 48,000 c.y. of material to be dredged.

It is important to note that the 4-foot cut need not be carried through to the actual dredging plan. The 4-foot cut is used solely as a guideline to establish the minimum number of required samples and analyses. In developing a sampling and compositing plan, and defining dredged material management units, it is important to ensure that dredged material acceptability decisions be fully reflective of the dredging plan, i.e., that the management units be truly "dredgeable."

Typically, several samples will be composited to provide the material for a single analysis. The number of samples that can be composited for a single analysis is presented in table A.6. In an area with a low ranking and at less than a 4-foot cut, each analysis can represent a composite of six samples.

The minimum number of samples and analyses required for a project will be determined prior to initiation of sampling. A sampling scheme would be developed based on information on the project submitted by the dredger during the initial review process. The sampling plan should be developed in close coordination with Corps, EPA, and Ecology representatives.

An initial tentative compositing scheme should be developed during this predredging planning process. Typically, compositing will follow the scheme outlined; however, special circumstances may warrant changes. Changes in sediment type, horizons, or lenses of material may indicate a difference in sediment which the dredger may wish to have analyzed separately. Any such change in compositing would be detailed in a formal report of the sampling and analyses program.

TABLE A.5

DREDGED MATERIAL MANAGEMENT UNITS 1/

Concern	Surface Sediment 4-Foot (Above Cut Depth)	Subsurface Sediment 4-Foot (Below Cut Depth)
Low	48,000	72,000
Low-Moderate	32,000	48,000
Moderate	16,000	24,000
High	4,000	12,000

1/Each management unit is the volume of sediment that may be characterized by a single analysis.

TABLE A.6

SEDIMENT ANALYSIS REQUIREMENTS

Above Ranking	Maximum Volume of Sediment Represented by Each Analysis (c.y.) Volume Above 4-Foot Cut Depth (Subsurface Sediment)	Volume Below 4-Foot Cut Depth (Subsurface Sediment)	Number of Samples/ Analysis Above	Below
Low	48,000	72,000	6	9
Low-Moderate	32,000	48,000	4	6
Moderate	16,000	24,000	4	6
High	4,000	12,000	1	3

Several requirements and recommendations for accomplishing the sampling and compositing plan are part of the PSDDA procedures. Station location for sampling will require high positioning precision due to the link between sample locations and the need for construction-level detail in the dredging plan. Precise station positioning allows the dredging contractor to discretely remove different management units (e.g., repeatable accuracy to within $\pm$ 2 m). Protocols for positioning were developed by PSDDA in conjunction with PSEP.

Sampling with either a coring device or a grab sampler is allowed, though coring is needed if sediments below a 4-foot cut depth will be dredged. A grab sampler can be used for collecting sediment for surface management units. The core section splits (when compositing) may vary from the proposed 4-foot cut depth if a visual layer between apparently contaminated (unacceptable for unconfined, open-water disposal) and clean (acceptable for unconfined, open-water disposal) material is seen at greater than the 4-foot depth. In such a case, the apparently contaminated material should be characterized without mixing with the cleaner material.

When taking a core, the coring depth will extend 1 foot beyond the project overdepth. (To collect this 1-foot, it may be necessary to core beyond the 1-foot line in order to secure an adequate sample.) This 1-foot sample will be collected and archived for possible analysis to evaluate the chemical concentration in sediments that will become the surface after dredging. The potential need for this analysis is discussed in EPTA.

Samples will be tracked according to procedures developed for PSEP. Proper chain-of-custody procedures enable the samples to be followed traced from collection to final disposition. Documents needed to maintain proper chain-of-custody include field logbook, sample labels and chain-of-custody records. The minimum information required in a sample tracking log includes sample identification number, location and condition of storage, date and time of each removal of and return to storage, signature of the person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

5. Chemical Tests. Chemical analysis includes both the measurement of "conventional" parameters and the measurement of concentrations of chemicals which PSDDA has identified as being of concern in dredged material because of the potential for unacceptable adverse effects.

"Conventional" parameters are required to be measured to further characterize the sediment in the management unit and to provide information to aid in interpreting chemical and biological tests. Conventionals that will be measured include:

- o Total volatile solids.
- o Grain size distribution.
- o Total organic carbon.
- o Percent solids.
- o Total sulfides.
- o Manganese.
- o Ammonia.

See EPTA for a discussion of the use of data from measurement of conventionals.

Chemical testing, when required, will generally involve analysis for 58 chemicals of concern (table A.7). Table A.7 also presents the guideline values for each chemical. Use of the guidelines values is discussed in section 6. The list of chemicals of concern for dredged material was developed based on a review of chemicals discharged into the Sound. The chemicals of concern generally have the following characteristics:

o A demonstrated or suspected effect on ecology or human health (i.e., the focus of chemical concerns is on ultimate biological effects).

o One or more present or historical sources of sufficient magnitude to be of concern (i.e., a focus on widespread distribution and high concentration relative to natural conditions).

o A potential for remaining in a toxic form for a long time in the environment.

o A potential for entering the food web.

The list was pared down from the 129 priority pollutants and 30+ hazardous substances, plus the many anthropogenic chemicals found by NOAA in a study of Commencement Bay sediments.

In addition to the standard chemicals of concern, there is a more limited list of chemicals of concern that need to be measured for dredging projects located near specific pollution sources. These chemicals include:

o Guaiacols.

o Chlorinated guaiacols.

o Chromium.

o Tri-, tetra-, and pentachlorobutadienes.

Guaiacols and chlorinated guaiacols are measured in areas where kraft pulp mills are located. Only guaiacols are recommended near sulfite pulp mills (chlorinated guaiacols are not expected in processes that do not involve bleaching).

TABLE A.7

SCREENING LEVEL (SL) AND MAXIMUM LEVEL (ML)
GUIDELINE CHEMISTRY VALUES 1/
(Dry Weight Normalized)

Chemical	SL	ML
Metals (PPM)		
Antimony	2.6	26
Arsenic	70	700
Cadmium	0.96	9.6
Copper	81	810
Lead	66	660
Mercury	0.21	2.1
Nickel	28	120
Silver	1.2	5.2
Zinc	160	1,600
Organics (PPB)		
LPAH	610	6,100
Naphthalene	210	2,100
Acenaphthylene	64	640
Acenaphthene	63	630
Fluorene	64	640
Phenanthrene	320	3,200
Anthracene	130	1,300
2-Methylnaphthalene	67	670
HPAH	1,800	51,000
Fluoranthene	630	6,300
Pyrene	430	7,300
Benzo(a)anthracene	450	4,500
Chrysene	670	6,700
Benzofluoranthenes	800	8,000
Benzo(a)pyrene	680	6,800
Indeno(1,2,3-c,d)pyrene	69	5,200
Dibenzo(a,h)anthracene	120	1,200
Benzo(g,h,i)perylene	540	5,400

1/Some of the SL and ML values shown in this table were adjusted in April 1988 as a result of information provided during the public review of the draft PSDDA Phase I documents. They represent the current guideline values for these chemicals of concern, subject to adjustment during annual review of the PSDDA program.

2/No ML has been established for these compounds (see EPTA).

TABLE A.7 (con.)

Chemical	SL	ML
Chlorinated Hydrocarbons		
1,3-Dichlorobenzene 2/	170	
1,4-Dichlorobenzene	26	260
1,2-Dichlorobenzene	19	350
1,2,4-Trichlorobenzene	6.4	64
HCB	23	230
Phthalates 2/		
Dimethyl phthalate	160	
Diethyl phthalate	97	
Di-n-butyl phthalate	1,400	
Butyl benzyl phthalate	470	
Bis(2-ethylhexyl)phthalate	3,100	
Di-n-octyl phthalate	69,000	
Phenols		
Phenol	120	1,200
2 Methylphenol	10	72
4 Methylphenol	120	1,200
2,4-Dimethyl phenol	10	50
Pentachlorophenol 2/	140	
Miscellaneous Extractables		
Benzyl alcohol	10	73
Benzoic acid	216	690
Dibenzofuran	54	540
Hexachloroethane	1,400	14,000
Hexachlorobutadiene	29	290
N-Nitrosodiphenylamine	22	220
Volatile Organics		
Trichloroethene	160	1,600
Tetrachloroethene	14	210
Ethylbenzene	10	50
Total Xylene	12	160

1/Some of the SL and ML values shown in this table were adjusted in April 1988 as a result of information provided during the public review of the draft PSDDA Phase I documents. They represent the current guideline values for these chemicals of concern, subject to adjustment during annual review of the PSDDA program.

2/No ML has been established for these compounds (see EPTA).

TABLE A.7 (con.)

Chemical	SL	ML
Pesticides		
Total DDT	6.9	69
Aldrin (b)	10	
Chlordane (b)	10	
Dieldrin (b)	10	
Heptachlor (b)	10	
Lindane (b)	10	
Total PCB's	130	2,500

Chromium appears to derive largely from the natural erosion of crustal rocks into Puget Sound, but localized sources of chromium also exist (e.g., plating industries and some chemical manufacturing facilities).

Tri-, tetra-, and pentachlorobutadienes are nonpriority pollutants that have been detected at highly elevated levels in certain areas of Puget Sound (e.g., Hylebos Waterway in Commencement Bay). Because standards are generally unavailable for these compounds, they are recommended for analysis only where chlorinated butadienes are suspected to have a major source.

Sediment sampling and chemical testing procedures for sediments to be used are generally those summarized in "Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound," prepared for PSEP. Metals, organics, and most sediment conventionals testing protocols will be those recommended by the PSEP for chemical analyses on Puget Sound sediments. Ammonia analysis should be conducted according to EPA/Corps national protocols. Reports submitted detailing chemical tests will report detection limits and report QA/QC as recommended by PSEP. (See EPTA for references to specific protocols.)

6. Chemical Disposal Guidelines. Chemical concentrations will be compared to two chemical guideline values presented in table A.7. First, a lower "screening level" (SL) has been defined for each chemical as a guideline to identify chemical concentrations below which there is no reason to believe that dredged material disposal would result in unacceptable adverse effects. For dredged material with chemical concentrations below the SL values, biological testing is not required to determine material suitability for unconfined, open-water disposal. Second, a higher "maximum level" (ML) has been defined for each chemical which corresponds to the concentration of a chemical in dredged material above which there is reason to believe that the material would be unacceptable for unconfined, open-water disposal.

When dredged material chemicals of concern exceed the ML values, the dredger has two options at this point. First, he may elect to accept the indication of the ML and conclude that the material is unsuitable for unconfined, open-water disposal. Biological testing is not required for this decision. If the dredger elects the second option, then additional, special biological testing is required as described in MPR chapter 5 (see paragraph 5.4.2).

For each management unit, the SL and ML guideline values will be used to determine whether biological testing is needed before a decision is made on the suitability for unconfined, open-water disposal. Four potential interpretations are possible:

a. All chemicals are below their SL's; no biological testing is needed; the management unit is considered suitable for unconfined, open-water disposal.

b. One or more chemicals are present at levels between SL and ML, standard biological testing (see figures A.1, A.3, and A.4) is needed.

c. A single chemical exceeds ML by less than 100 percent (i.e., less than twice the ML value), standard biological testing is needed.

d. A single chemical exceeds ML by more than 100 percent (i.e., twice the ML value) or two or more chemicals are above the ML; no biological testing is needed; there is reason to believe the management unit is unacceptable for unconfined, open-water disposal. However, the dredger has the option to accept the indication of the ML or conduct biological testing as described in MPR chapter 5.

7. Biological Tests Proposed Under PSDDA. Ideal bioassessment of the potential effects of dredged material disposal would include a determination of the short- and long-term effects of environmental exposures of ecologically important species found near the disposal site to a representative sample of the material to be disposed. In practice, such bioassessment is difficult to simulate in the laboratory and is never achieved. Limitations on technical abilities to develop laboratory exposure environments and tests with benthic species found near disposal sites, and prohibitive costs in time and money to conduct such tests, makes these efforts unrealistic. Consequently, the approach most often adopted is to expose representative marine species for relatively short periods of time (10 days in acute toxicity; 30 days for bioaccumulation tests) to different phases (primarily solid phase) of whole sediment samples of the dredged material. In some cases, the species used in the assessment is commonly associated with benthic communities in and around the disposal site. More often than not, however, the species used are surrogates not found in the area of the disposal site. As a result, laboratory assessments are several steps removed ("remote") from conditions that will occur in the field. Because of the remoteness of the tests relative to the potential effects at the disposal site, the ecological meaning of the test results cannot be fully estimated at present. Therefore, though initial interpretive guidance is based on a statistical interpretation of the test results, additional professional judgment is required to determine how biological test results might relate to effects at the disposal site. To assist regions of the country in developing and interpreting bioassays relative to dredged material evaluation, the Corps and EPA produced a technical guidance manual which provides guidelines for evaluation (EPA/COE, 1977).

The biological testing recommendations developed by PSDDA have been designed to address both whole sediment toxicity and potential water column effects.

Testing includes evaluation of sediment toxicity using five organisms (amphipods, juvenile bivalve, oyster (or other) larvae, bacteria (used in Microtox pursuant to Section 401 requirements), and adult bivalve (figures A.2 and A.3). The recommended tests also allow for an evaluation of potential water column effects using a separate larval bioassay, when warranted. All of the proposed tests have been previously conducted on dredging projects within Puget Sound. Specific details on the recommended biological tests are provided in EPTA.

In several cases, the protocols used with the bioassays are described by PSEP, found in PSEP report "Recommended Protocols for Conducting Bioassays on Puget Sound Sediments." For the amphipod, sediment larval, and Microtox tests, the PSEP protocols describe field collection and processing methods, QA/QC, and data reporting procedures. General protocols were provided for field collection of surficial test sediments and for general QA/QC procedures that apply to all sediment bioassays. For microtox, use of the saline extract method is proposed, though the organic extract may also be used. Protocols for the larval water column test were modified from those described in the ocean disposal implementation manual. A standardized method for conducting the juvenile bivalve test is not currently available, though the test can be conducted by adapting readily available methods.

When required, a bioaccumulation test will be conducted using an adult bivalve from the genus Macoma. The exposure duration will be 30 days after which a chemical analysis will be made of the tissue residue to determine the concentration of selected chemicals of human health concern. The bioaccumulation test will only be conducted on those dredged materials proposed for dredging in which the sediment chemistry levels are above the specified PSDDA guideline values PSDDA has established (table A.8). When required, this test will be conducted on no more than one-half of the analyses (composited samples) for any given project. Bioaccumulation data, when required will be used to interpret potential effects to human health.

Standard protocols for the bioaccumulation test are not currently available. Procedures developed for the test will be based on bioaccumulation bioassays conducted with dredged material over the past several years. Protocols for tissue digestion and chemical analysis will follow the PSEP-recommended procedures.

For most biological tests, both a control and a reference sediment will be run with each test. The control sediment will be from the collection site of either the amphipod or juvenile bivalve test organisms, with additional sediment collected for the larval and Microtox control, as needed. The control provides an estimate of test organism general health during the test exposure period. The reference sediment will be collected from one of the suggested reference sediment collection sites and should be compatible on a physical and grain size basis with the dredged material. The primary purpose of the reference is to determine the response of the test organisms to sediments of physical characteristics similar to the proposed dredged material. Specific reference sites are listed in EPTA. For dredged material with relatively coarse-grained sediments, the dredger can opt to rely solely on a control sediment (acting as both reference and control).

TABLE A.8

SEDIMENT CHEMISTRY GUIDELINE VALUES
FOR BIOACCUMULATION

Chemical	Concentration 1/
Metals (mg/kg dry weight)	
Antimony	19
Arsenic	511
Mercury	1.5
Nickel	43
Silver	4
Organic Compounds (ug/kg dry weight)	
Flouranthene	4,600
Benzo(a)pyrene	4,964
1,2-Dichlorobenzene	37
1,3-Dichlorobenzene	1,241 2/
1,4-Dichlorobenzene	190
Dimethyl phthalate	1,168 2/
Di-n-butyl phthalate	10,220 2/
Bis(2-ethylhexyl) phthalate	13,870 2/
Hexachloroethane	1,022
Hexachlorobutadiene	212
Phenol	676
Pentachlorophenol	1,022 2/
Ethylbenzene	27
N-Nitrosodiphenylamine	161
Hexachlorobenzene	168
Trichloroethene	1,168
Tetrachloroethane	102
Total DDT	50
Aldrin	37 2/
Chlordane	37 2/
Dieldrin	37 2/
Heptachlor	37 2/
Total PCBs	1,789

1/Concentration = 0.7 * (ML - SL) + SL; When the concentration of any chemical is above this value, a bioaccumulation test must be conducted on the sediment. As a result of information received during public review of the Phase I documents, several of the SL and ML values have been updated (see table A.7 for current values). The older SL and ML values were used to calculate these bioaccumulation sediment guidelines, which were left unchanged pending development of additional information and annual review of the PSDDA program.

2/These chemicals do not have an ML value. Therefore, the concentration = ((10SL - SL) * 0.7) + SL = 7.3 * SL.

For acute bioassays that measure percent mortality (all except Microtox), both the control and the reference have test performance standards that must be met. For the control, mortality over the exposure period must be less than 10 percent (absolute). This represents a generally accepted level of mortality of test organisms under control conditions, where the bioassay (in terms of test organism health) is still considered a valid measure of effects of the test treatments. If control mortality is greater than 10 percent, the bioassay must be repeated.

The performance standard for the reference is less than 20 percent (absolute) mortality over control during the exposure period. When mortality exceeds 20 percent over control in a reference sediment, the bioassay must be rerun with a new sediment sample from a reference area.

8. Biological Response Disposal Guidelines. The response of test organisms to the dredged material tests will be statistically compared to the response of these organisms to both control and reference sediments in establishing if the material is suitable for unconfined, open-water disposal. A determination of "statistically significant" acute response also requires that total mortality in the dredged material test to be greater than 20 percent (absolute) over the control results (i.e., exceeds the "performance standard" for reference test results; see EPTA).

The interpretation of biological test results will differ slightly between the Section 404(b)(1) evaluation and the Section 401 water quality certification review (figure A.3). The recommended disposal guidelines, including both minor differences between Sections 404 and 401 as well as the combined "net effect," are described below.

a. Test Interpretation for Section 404(b)(1) Evaluations. If both the amphipod and the juvenile bivalve show "statistically significant" (see EPTA for definition) acute toxicity relative to the reference sample results, the materials are judged to be unacceptable for unconfined, open-water disposal. Alternately, the amphipod or juvenile clam response alone may serve to indicate material unsuitability. If the dredged material total mortality in either of these tests is significantly greater than the total mortality in the reference (more than 30 percent absolute), and if the dredged material test result is "statistically significant" relative to reference, the material is considered unacceptable for unconfined, open-water disposal.

Interpretation of the water column larval test requires an assessment of the possibility of unacceptable adverse effects occurring in the water column. The appropriate assessment is described in the EPA/Corps implementation manual for ecological evaluation of dredged material disposal in ocean waters (appendixes B, D, and H). The assessment is done by statistically comparing the larval survival after 96 hours in the seawater control to survival in the dredged material suspended phase exposures, including the consideration of initial mixing that might occur at the disposal site. As described in the implementation manual, the dredged material will be considered acceptable for unconfined, open-water disposal only if the test results and initial mixing

calculations (after 4 hours) indicate the that the "limiting permissible concentration" (LPC) would not be exceeded. The LPC is the concentration of the dredged material suspended phase which, after allowance for initial mixing, will not exceed a toxicity threshold defined as 0.01 of a concentration shown to be acutely toxic (LC50) to the larvae. In other words, the larval test will indicate that the material is suitable for unconfined, open-water disposal if one one-hundredth (0.01) of the concentration resulting in 50 percent mortality of the larvae (LC50) is not expected to be exceeded after 4 hours of mixing at the disposal site. Appendixes D and H of the EPA/Corps manual for implementation of Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (EPA/Corps, 1977) provide further details on data analysis and interpretation to be used with the water column larval test conducted pursuant to Section 404 ecological evaluations.

For the bioaccumulation test, the results are compared to guideline values to determine exceedance of allowable tissue residue concentrations. If the 30-day bioaccumulation test results in tissue levels greater than the PSDDA target tissue concentration values, the sediment is considered unacceptable for unconfined, open-water disposal.

b. Test Interpretation for Section 401 Water Quality Certification Reviews. If any two of four acute tests (amphipod, juvenile bivalve, sediment larval, or Microtox bioassays) show "statistically significant" acute toxicity relative to the reference sample results, the material is judged to be unacceptable for unconfined, open-water disposal.

The juvenile bivalve, amphipod, or sediment larval mortality response alone may serve to indicate material unacceptability. If the dredged material total mortality in any one of these three tests is significantly greater than the total mortality in the reference (more than 30 percent absolute), and if the test material is "statistically significant" relative to reference, the material is considered unacceptable for unconfined, open-water disposal.

The Microtox test result alone is not used to judge material acceptability. However, it may be used in combination with the juvenile bivalve, oyster (or other) larvae or the amphipod tests to determine acceptability for unconfined, open-water disposal.

Interpretation of bioaccumulation test results are identical to those described for the Section 404(b)(1) evaluation.

c. The "Net Effect" of Combined Test Interpretation. Section 404 and Section 401 interpretations of biological tests are identical for the amphipod, juvenile bivalve, and adult bivalve bioaccumulation. The two evaluations differ in the method and interpretation of the larval test, with Section 404 utilizing a water column effects assessment and Section 401 utilizing a sediment toxicity approach. The Microtox test results are only used in the Section 401 assessment.

The PSDDA biological response disposal guidelines result from the combination of Section 404 and Section 401 requirements. Since all requirements must be met before dredged material can be discharged in Puget Sound waters, the dredger will be interested primarily in "net effect" of the combined requirements. These are described below.

If any two of the four acute tests (amphipod, juvenile bivalve, sediment larval, or Microtox bioassays) show "statistically significant" acute toxicity relative to the reference sample results, the material is judged to be unacceptable for unconfined, open-water disposal. For example, the following test results would indicate that the management unit is unacceptable for unconfined, open-water disposal:

juvenile bivalve mortality	amphipod mortality
control: 5 (mean value) ±5%	control: 0 (mean value) ±0%
reference: 10 (mean value) ±6%	reference: 5 (mean value) ±5%
dredged material: 30 (mean value) ±10%	dredged material: 25 (mean value) ±7%

In this case, the dredged material test results are 25 percent (absolute) over control for both the juvenile bivalve and amphipod, exceeding the "20 percent (absolute) over control" guideline.

The amphipod, juvenile bivalve, or sediment larval mortality response alone may serve to indicate material unsuitability. If the management unit mean total mortality of any one of these tests is greater than 30 percent (absolute) over mean total mortality in the reference, and if the test material is statistically significant relative to reference, the material is considered unacceptable. For example, the amphipod bioassay can indicate that dredged material is unacceptable for unconfined, open-water disposal as follows:

juvenile bivalve mortality	amphipod mortality
control: 5 (mean value) ±5%	control: 0 (mean value) ±0%
reference: 10 (mean value) ±6%	reference: 5 (mean value) ±5%
dredged material: 10 (mean value) ±10%	dredged material: 50 (mean value) ±10%

In this case, while the juvenile bivalve test did not indicate any significant acute toxicity, the amphipod test showed 45 percent (absolute) higher mean mortality than the reference, which exceeds the "30 percent over reference" guideline.

As stated in paragraph 8a, interpretation of the water column larval test requires an assessment of the possibility of unacceptable adverse effects

occurring in the water column. The water column larval test will indicate that the material is acceptable for unconfined, open-water disposal if one one-hundredth (0.01) of the concentration resulting in 50 percent mortality of the larvae (LC50) is not expected to be exceeded after 4 hours of mixing at the disposal site.

The Microtox test result alone is not used to judge material acceptability. However, it may be used in combination with the other tests to determine acceptability for unconfined, open-water disposal. For purposes of corroborating other test results, a significant response for saline-extract microtox is defined as a dredged material extract concentration decrease of 20 percent or more below reference extract (15 min. EC 50) (also statistically different from reference). For example, the following data would be indicative of an unacceptable (per Section 401) dredged material:

Microtox test results (ul/l, 15 min. EC50)	amphipod mortality (percent, absolute)
control: 100 ± 2	control: 0 (mean) ± 0%
reference: 90 ± 5	reference: 5 (mean) ± 5%
dredged material: 45 ± 10	dredged material: 25 (mean) ± 7%

In this case, the dredged material test results are 25 percent (absolute) over control for the amphipod (exceeding the "20 percent over control" guideline), and are 50 percent below the reference value for Microtox (exceeding the "20 percent below" guideline). Both tests are statistically different from reference.

For the bioaccumulation test, the results are compared to guideline values to determine exceedance of allowable tissue residue concentrations. If the 30-day bioaccumulation test results in tissue levels greater than the target tissue concentration values in table A.9, the sediment is considered unacceptable for unconfined, open-water disposal. For several of the chemicals listed in the table, the high guideline values suggest that exceedance of the guideline is unlikely. However, insufficient data are available to allow deleting these chemicals from the list at this time. It is anticipated that dredged material bioaccumulation testing will provide sufficient information in the near future to allow reduction of the list of human health chemicals of concerns.

d. The Role of Statistical Significance. The use of statistics in the data analysis phase is to identify whether observed differences of the control or reference treatments compared to the dredged material sample treatments are significant. Statistics are primarily applied in the initial data analysis stage of the PSDDA disposal guidelines. Statistical significance is used to determine if observed differences are "potentially real" when natural variability of the parameters being measured is considered. Statistics consider

TABLE A.9

TARGET TISSUE CONCENTRATION VALUES
FOR CHEMICALS OF CONCERN TO HUMAN HEALTH

Chemical	Tissue Guidelines1/ (all ppm)
Metals	
Antimony	5,600.0
Arsenic	10.1 2/
Mercury	300.0
Nickel	20,000.0
Silver	200.0
Organic Compounds	
Fluoranthene	8,400.0
Benzo(a)pyrene	1.2
1,2-Dichlorobenzene	300.0
1,3-Dichlorobenzene	300.0
1,4-Dichlorobenzene	300.0
Diethyl phthalate	300,000.0
Di-n-butyl phthalate	30,000.0
Bis(2-ethylhexyl) phthalate	18,000.0
Hexachloroethane	98.0
Hexachlorobutadine	180.0
Phenol	3,000.0
Pentachlorophenol	900.0
Ethylbenzene	600.0
N-nitrosodiphenylamine	2,845.0
Hexachlorobenzene	180.0
Trichloroethene	127.0
Tetrachloroethene	27.0
Total DDT	41.0
Aldrin	1.2
Chlordane	3.7
Dieldrin	0.46
Heptachlor	4.2
Total PCBs	3.2

1/Development of the tissue guidelines is described in EPTA. The guidelines result from an exposure analysis that calculates potential transfer of chemicals of concern from the disposal site to humans via seafood consumption. The estimated low potential for this transfer results in relatively high tissue values for interpretation of lab tests.

2/Adjusted based on reported ratio of inorganic to organic As (Tetra Tech, 1986a).

the accuracy and acceptability of the bioassays in indicating whether the observed differences warrant further professional evaluation. However, statistical significance does not imply ecological significance and professional judgment is essential in interpreting bioassay results.

Analysis of testing data consists of a comparison to guideline values that were developed using statistical significance as a clear indicator that toxicity was evident in the results. However, ecological significance is not inherently implied by the statistics in the inital data anlaysis step. The subsequent data interpretation step requires both an understanding of the data evaluation procedures and professional judgment in determining the ecological significance of the test results. And in addition to data, management of unconfined, open-water disposal may be further influenced by administrative considerations of factors such as size of the proposed discharge, the degree of environmental risk that the discharge may present, and other project-specific features.

9. Reporting Requirements. Following sampling, testing, and data evaluation, the dredger for a permit application applicant must submit a formal report of the results to the Corps, EPA, and Ecology for their review. The report must:

a. identify any deviations or changes from the proposed testing plan,

b. include appropriate plan and side view drawings to show where core samples were collected and the sectioning of the cores which was undertaken, and

c. present results of chemical and biological analyses, including required QA/QC. Chemical and biological analyses summary tables must be included. (Note: The table format will be formalized after a "user manual" has been completed by Ecology (expected by the winter of 1988). This standard table will assist project review and data management.)

10. Use of Test Results in Permit Decisions. The PSDDA evaluation procedures will be applied and considered as appropriate under Sections 401 and 404 on a project-specific basis. In applying the procedures to specific projects, if the permitting agencies depart from the technical recommendations of the disposal guidelines, the permitting agencies will document the technical rationale for this departure.

11. Review of Evaluation Procedures. Because the proposed procedures contain several features that have not received full implementation in a regulatory program prior to PSDDA, annual reviews of the evaluation procedures will be undertaken once the procedures have been applied. In many cases during development of the procedures, data were not sufficient to fully resolve key issues, or to fully judge the impact of the proposed procedures. Consequently, the annual review process is essential to incorporate what is learned after implementation, allowing appropriate adjustments to be made.

A number of topics of concern have been identified for specific review following implementation of PSDDA. These are detailed in EPTA.

EXHIBIT B:

MODEL SHORELINE MASTER PROGRAM ELEMENT

UNCONFINED, OPEN-WATER DREDGED MATERIAL DISPOSAL

Exhibit B

Model Shoreline Master Program Element
Unconfined, Open-Water Dredged Material Disposal

Policies

A. Selection of unconfined, open-water disposal sites should follow the process developed in the Puget Sound Dredged Disposal Analysis (PSDDA) and incorporated into DNR WAC 332-30-166 Open Water Disposal Sites.

B. Unconfined, open-water disposal of dredged material should occur at the _____ disposal site, as identified in the final Puget Sound Dredged Disposal Analysis report and adopted by the Washington Departments of Natural Resources and Ecology.

C. Due to the necessity of managing unconfined, open-water dredged material disposal on a regional basis, the _____ disposal site will serve several jurisdictions. However, the character and total volume of material deposited on the site from all sources shall comply with the standards contained in the final PSDDA report.

D. The quality of material dumped at the _____ disposal site shall meet the standards established in the final PSDDA study for unconfined open-water disposal and adopted by Ecology.

E. Due to the need for long-term management of open-water disposal sites, a public agency may acquire an exclusive permit for managing use of the _____ disposal site.

F. The long term environmental impact of disposal at the _____ site shall be monitored by the shoreline management permittee. The permittee shall provide for long-term environmental monitoring and any necessary remedies. Periodic reports on site use and environmental impact shall be submitted to the _____ Planning Department.

Regulations

1. Unconfined, open-water disposal of dredged material shall only occur at sites identified through the process defined in the final PSDDA Study document and incorporated in DNR WAC 332-30-166 Open Water Disposal Sites.

2. The _____ disposal site shall be managed in accordance

with the final PSDDA Study document and subsequent revisions.

3. General Permit Procedures

   A. To assure that dredged material disposal operations are consistent with this program, no disposal of dredged materials may occur at the _____ disposal site unless authorized by a shoreline management permit. Federal use of the site must be found to be consistent to the maximum extent practicable with the provisions of this Shoreline Management Master Program and, by reference, with the final PSDDA report.

   B. It shall be the responsibility of the permit holder to assure that disposal of dredged material and management of the disposal site comply with the permit conditions and with the PSDDA report.

   C. Review of applications for use of the disposal site shall be based on the criteria and guidelines established through the final PSDDA study.

3. Exclusive Use Permits

   A. An exclusive permit for use of the _____ disposal site may be issued to a public agency when that agency maintains total management control of the site. The agency shall be responsible for managing the site in accordance with the terms of the shoreline permit.

   B. Yearly status reports shall be required of the agency. The reports shall state the quantity of material dumped, characterize the quality of the material, and review any other factors necessary to determine continuing compliance with the shoreline management substantial development permit. When such a permit has been issued, no other shoreline permits will be issued for use of the site without permission of the site managing agency.

   C. The term for exclusive site management permits issued to public agencies will be five years with a one year extension option, unless a shorter term is requested by the agency. However, if longer permit terms are allowed by the Department of Ecology, the permit term shall be indefinite. This indefinite term shall be contingent on inspection and environmental monitoring programs established in accordance with the final PSDDA report to ensure that environmental impacts are as predicted.

GLOSSARY OF TERMS AND ABBREVIATIONS

PUGET SOUND DREDGED DISPOSAL ANALYSIS (PSDDA)
GLOSSARY OF TERMS

Amphipods. Small shrimp-like crustaceans (for example, sand fleas). Many live on the bottom, feed on algae and detritus, and serve as food for many marine species. Amphipods are used in laboratory bioassays to test the toxicity of sediments.

Apparent Effects Threshold. The sediment concentration of a contaminant above which statistically significant biological effects would always be expected.

Area Ranking. The designation of a dredging area relative to its potential for having sediment chemicals of concern. Rankings range from "low" potential to "high" potential, and are used to determine the intensity of dredged material evaluation and testing that might be required.

Baseline Study. A study designed to document existing environmental conditions at a given site. The results of a baseline study may be used to document temporal changes at a site or document background conditions for comparison with another site.

Bathymetry. Shape of the bottom of a water body expressed as the spatial pattern of water depths. Bathymetric maps are essentially topographic maps of the bottom of Puget Sound.

Benthic Organisms. Organisms that live in or on the bottom of a body of water.

Bioaccumulation. The accumulation of chemical compounds in the tissues of an organism. For example, certain chemicals in food eaten by a fish tend to accumulate in its liver and other tissues.

Bioassay. A laboratory test used to evaluate the toxicity of a material (commonly sediments or wastewater) by measuring behavioral, physiological, or lethal responses of organisms.

Biota. The animals and plants that live in a particular area or habitat.

Bottom-Dump Barge. A barge that disposes of dredged material by opening along a center seam or through doors in the bottom of the barge.

Bottomfish. Fish that live on or near the bottom of a body of water, for example, English sole.

Bulk Chemical Analyses. Chemical analyses performed on an entire sediment sample, without separating water from the solid material in a sample.

Capping. See confined aquatic disposal.

Carcinogenic. Capable of causing cancer.

Clamshell Dredging. Scooping of the bottom sediments using a mechanical clamshell bucket of varying size. Commonly used in over a wide variety of grain sizes and calm water, the sediment is dumped onto a separate barge and towed to a disposal site when disposing in open water.

Code of Federal Regulations. The compilation of Federal regulations adopted by Federal agencies through a rule-making process.

Compositing. Mixing sediments from different samples to produce a composite sample for chemical and/or biological testing.

Confined Disposal. A disposal method that isolates the dredged material from the environment. Confined disposal may be in aquatic, nearshore, or upland environments.

Confined Aquatic Disposal (CAD). Confined disposal in a water environment. Usually accomplished by placing a layer of sediment over material that has been placed on the bottom of a water body (i.e., capping).

Contaminant. A chemical or biological substance in a form or in a quantity that can harm aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment.

Contaminated Sediment.

Technical Definition: A sediment that contains measurable levels of contaminants.

Management or Common Definition: A sediment that contains sufficient concentration(s) of chemicals to produce unacceptable adverse environmental effects and thus require restriction(s) for dredging and/or disposal of dredged material (e.g., is unacceptable for unconfined, open water disposal or conventional land/shore disposal, requiring confinement).

Conventional Nearshore Disposal. Disposal at a site where dredged material is placed behind a dike in water along the shoreline, with the final elevation of the fill being above water. "Conventional" disposal additionally means that special contaminant controls or restrictions are not needed.

Conventional Pollutants. Sediment parameters and characteristics that have been routinely measured in assessing sediment quality. These include sulfides, organic carbon, etc.

Conventional Upland Disposal. Disposal at a site created on land (away from tidal waters) in which the dredged material eventually dries. Upland sites are usually diked to confine solids and to allow surface water from the disposal operation to be released. "Conventional" disposal additionally means that special contaminant controls or restrictions are not needed.

Depositional Analysis. A scientific inspection of the bottom sediments that identifies where natural sediments tend to accumulate.

Depositional Area. An underwater region where material sediments tend to accumulate.

Disposal. See confined disposal, conventional nearshore disposal, conventional upland disposal, and unconfined, open-water disposal.

Disposal Site. The bottom area that receives discharged dredged material; encompassing, and larger than, the target area and the disposal zone.

Disposal Site Work Group. The PSDDA work group that is designating locations for open-water unconfined dredged material disposal sites that are environmentally acceptable and economically feasible.

Disposal Zone. The area that is within the disposal site that designates where surface release of dredged material will occur. It encompasses the smaller target area. (See also "target area" and "disposal site".)

Dredged Material. Sediments excavated from the bottom of a waterway or water body.

Dredged Material Management Unit. The maximum volume of dredged material for which a decision on suitability for unconfined open-water disposal can be made. Management units are typically represented by a single set of chemical and biological test information obtained from a composite sample. Management units are smaller in areas of higher chemical contamination concern (see "area ranking").

Dredger. Private developer or public entity (e.g., Federal or State agency, port or local government) responsible for funding and undertaking dredging projects. This is not necessarily the dredging contractor who physically removes and disposes of dredged material (see below).

Dredging. Any physical digging into the bottom of a water body. Dredging can be done with mechanical or hydraulic machines and is performed in many parts of Puget Sound for the maintenance of navigation channels that would otherwise fill with sediment and block ship passage.

Dredging Contractor. Private or public (e.g., Corps of Engineers) contractor or operator who physically removes and disposes of dredged material for the dredger (see above).

Disposal Site Work Group. The PSDDA work group that is designating locations for open-water unconfined dredged material disposal sites that are environmentally acceptable and economically feasible.

Ecosystem. A group of completely interrelated living organisms that interact with one another and with their physical environment. Examples of ecosystems

are a rain forest, pond, and estuary. An ecosystem, such as Puget Sound, can be thought of as a single complex system. Damage to any part may affect the whole. A system such as Puget Sound can also be thought of as the sum of many interconnected ecosystems such as the rivers, wetlands, and bays. Ecosystem is thus a concept applied to various scales of living communities and signifying the interrelationships that must be considered.

Effluent. Effluent is the water flowing out of a contained disposal facility. To distinguish from "runoff" (see below) due to rainfall, effluent usually refers to water discharged during the disposal operation.

Elutriate. The extract resulting from mixing water and dredged material in a laboratory test. The resulting elutriate can be used for chemical and biological testing to assess potential water column effects of dredged material disposal.

Entrainment. The addition of water to dredged material during disposal, as it descends through the water column.

Environmental Impact Statement. A document that discusses the likely significant environmental impacts of a proposed project, ways to lessen the impacts, and alternatives to the proposed project. EIS's are required by the National and State Environmental Policy Acts.

Erosion. Wearing away of rock or soil via gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces.

Estuary. A confined coastal water body where ocean water is diluted by inflowing fresh water, and tidal mixing occurs.

Evaluation Procedures Work Group. The PSDDA work group that is developing chemical and biological testing and test evaluation procedures for dredged material assessment.

Gravid. Having eggs, such as female crabs carrying eggs.

Ground Water. Underground water body, also called an aquifer. Aquifers are created by rain which soaks into the ground and flows down until it collects at a point where the ground is not permeable.

Habitat. The specific area or environment in which a particular type of plant or animal lives. An organism's habitat provides all of the basic requirements for life. Typical Puget Sound habitats include beaches, marshes, rocky shores, bottom sediments, mudflats, and the water itself.

Hazardous Waste. Any solid, liquid, or gaseous substance which, because of its source or measurable characteristics, is classified under State or Federal law as hazardous, and is subject to special handling, shipping, storage, and disposal requirements. Washington State law identifies two categories of hazardous waste: dangerous and extremely hazardous. The latter category is more hazardous and requires greater precautions.

Hopper Dredge. A hydraulic suction dredge that is used to pick up coarser grain sediments (such as sand), particularly in less protected areas with sea swell. Dredged materials are deposited in a large holding tank or "hopper" on the same vessel, and then transported to a disposal site. The hopper dredge is rarely used in Puget Sound.

Hydraulic Dredging. Dredging accomplished by the erosive force of a water suction and slurry process, requiring a pump to move the water-suspended sediments. Pipeline and hopper dredges are hydraulic dredges.

Hydraulics Project Approval. RCW 75.20.100 Approval from the Washington Department of Fisheries and Washington Department of Wildlife for the use, diversion, obstruction or change in the natural flow or bed of any river or stream, or that will use any salt or fresh waters of the State.

Hydraulically Dredged Material. Material, usually sand or coarser grain, that is brought up by a pipeline or hopper dredge. This material usually includes slurry water.

Hydrocarbon. An organic compound composed of carbon and hydrogen. Petroleum and its derived compounds are hydrocarbons.

Infauna. Animals living in the sediment.

Intertidal Area. The area between high and low tide levels. The alternate wetting and drying of this area makes it a transition between land and water organisms and creates special environmental conditions.

Leachate. Water or other liquid that may have dissolved (leached) soluble materials, such as organic salts and mineral salts, derived from a solid material. Rainwater that percolates through a sanitary landfill and picks up contaminants is called the leachate from the landfill.

Local Sponsor. A public entity (e.g., port district) that sponsors Federal navigation projects. The sponsor seeks to acquire or hold permits and approvals for disposal of dredged material at a disposal site.

Loran C. An electronic system to facilitate navigation positioning and course plotting/tracking.

Management Plan Work Group. The PSDDA work group is developing a management plan for each of the open-water dredged material disposal sites. The plan will define the roles of local, State, and Federal agencies. Issues being addressed include: permit reviews, monitoring of permit compliance, treatment of permit violations, monitoring of environmental impacts, responding to unforeseen effects of disposal, plan updating, and data management.

Material Release Screen. A laboratory test proposed by PSDDA to assess the potential for loss of fine-grained particles carrying chemicals of concern from the disposal site during disposal operations.

Mechanical Dredging. Dredging by digging or scraping to collect dredged materials. A clamshell dredge is a mechanical dredge. (See "hydraulic dredging.")

Metals. Metals are naturally occurring elements. Certain metals, such as mercury, lead, nickel, zinc, and cadmium, can be of environmental concern when they are released to the evironment in unnatural amounts by man's activities.

Microlayer, Sea Surface Microlayer. The extremely thin top layer of water that can contain high concentrations of natural and other organic substances. Contaminants such as oil and grease, many lipophylic (fat or oil associated) toxicants, and pathogens may be present at much higher concentrations in the microlayer than they are in the water column. Also the microlayer is biologically important as a rearing area for marine organisms.

Microtox. A laboratory test using luminescent bacteria and measuring light production, used to assess toxicity of sediment extracts.

Molt. A complex series of events that results in the periodic shedding of the skeleton, or carapace by crustaceans (all arthropods for that matter). Molting is the only time that many crustaceans can grow and mate (particularly crabs).

Monitor. To systematically and repeatedly measure something in order to detect changes or trends.

Nutrients. Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to accelerated growth of algae and subsequent degradation of water quality due to oxygen depletion. Some nutrients can be toxic at high concentrations.

Overdepth Material. Dredged material removed from below the dredging depth needed for safe navigation. Through overdepth is incidentally removed due to dredging equipment precision, its excavation is usually planned as part of the dredging project to ensure proper final water depths. Common overdepth is 2 feet below the needed dredging line.

Oxygen Demanding Materials. Materials such as food waste and dead plant or animal tissue that use up dissolved oxygen in the water when they are degraded through chemical or biological processes. Chemical and biological oxygen demand (COD and BOD, respectively) are different measures of how much oxygen demand a substance has.

Parameter. A quantifiable or measurable characteristic of something. For example, height, weight, sex, and hair color are all parameters that can be determined for humans. Water quality parameters include temperature, pH, salinity, dissolved oxygen concentration, and many others.

Pathogen. A disease-causing agent, especially a virus, bacteria, or fungi. Pathogens can be present in municipal, industrial, and nonpoint source discharges to the Sound.

Permit. A written warrant or license, granted by an authority, allowing a particular activity to take place. Permits required for dredging and disposal of dredged material include the U.S. Army Corps of Engineers Section 404 permit, the Washington State Department of Fisheries Hydraulics Permit, the city or county Shoreline Development Permit, and the Washington Department of Natural Resources Site Use Disposal Permit.

Persistent. Compounds that are not readily degraded by natural physical, chemical, or biological processes.

Pesticide. A general term used to describe any substance, usually chemical, used to destroy or control organisms (pests). Pesticides include herbicides, insecticides, algicides, and fungicides. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins which are extracted from plants and animals.

pH. The degree of alkalinity or acidity of a solution. Water has a pH of 7.0. A pH of less than 7.0 indicates an acidic solution, and a pH greater than 7.0 indicates a basic solution. The pH of water influences many of the types of chemical reactions that occur in it. Puget Sound waters, like most marine waters, are typically pH neutral.

Phase I. The PSDDA study is divided into two, 3-year long, overlapping phases. Phase I covers the central area of Puget Sound including Seattle, Everett, and Tacoma. Phase I began in April 1985.

Phase II. The PSDDA study is divided into two, 3-year long, overlapping phases. Phase II covers the north and south Sound (including, Olympia, Bellingham, and Port Angeles)--the areas not covered by Phase I. Hood Canal is not being considered for location of a disposal site. Phase II began in April 1986.

Pipeline Dredge. A hydraulic dredge that transports slurried dredged material by pumping it via a pipe. (See "hydraulic dredge".)

Point Source. Locations where pollution comes out of a pipe into Puget Sound.

Polychaete. A marine worm.

Polychlorinated Biphenyls. A group of manmade organic chemicals, including about 70 different but closely related compounds made up of carbon, hydrogen, and chlorine. If released to the environment, they persist for long periods of time and can concentrate in food chains. PCB's are not water soluble and are suspected to cause cancer in humans. PCB's are an example of an organic toxicant.

Polycyclic (Polynuclear) Aromatic Hydrocarbon. A class of complex organic compounds, some of which are persistent and cancer-causing. These compounds are formed from the combustion of organic material and are ubiquitous in the environment. PAH's are commonly formed by forest fires and by the combustion

of fossil fuels. PAH's often reach the environment through atmospheric fallout, highway runoff, and oil discharge.

Priority Pollutants. Substances listed by EPA under the Clean Water Act as toxic and having priority for regulatory controls. The list includes toxic metals, inorganic contaminants such as cyanide and arsenic, and a broad range of both natural and artificial organic compounds. The list of priority pollutants includes substances that are not of concern in Puget Sound, and also does not include all known harmful compounds.

Puget Sound Water Quality Authority. An agency created by the Washington State legislature in 1985 and tasked with developing a comprehensive plan to protect and enhance the water quality of Puget Sound. The Authority adopted its first plan in January 1987.

Range Markers. Pairs of markers which, when aligned, provide a known bearing to a boat operator. Two pairs of range markers can be used to fix position at a point.

Regional Administrative Decisions. A term used in PSDDA to describe decisions that are a mixture of scientific knowledge and administrative judgment. These regionwide policies are collectively made by all regulatory agencies with authority over dredged material disposal to obtain Sound-wide consistency.

Regulatory Agencies. Federal and State agencies that regulate dredging and dredged material disposal in Puget Sound, along with pertinent laws/permits, include:

U.S. Army Corps of Engineers

- o River and Harbor Act of 1899 (Section 10 permits)
- o Clean Water Act (Section 404 permits)

U.S. Environmental Protection Agency

- o Clean Water Act (Section 404 permits)

Washington Department of Natural Resources

- o Shoreline Management Act (site use permits)

Washington Department of Ecology

- o Clean Water Act (Section 401 certifications)
- o Shoreline Management Act (CZMA consistency determinations)

Washington Department of Fisheries

- o Hydraulics Project Approval

Washington Department of Wildlife (Formerly Washington Department of Game)

- o Hydraulics Project Approval

Local shoreline jurisdiction e.g., City of Seattle, City of Everett, Pierce County

- o Shoreline permit to non-Federal dredger/DNR

U.S. Fish and Wildlife Service (Key reviewing agency)

National Marine Fisheries Service (Key reviewing agency)

The Resource Conservation and Recovery Act. The Federal law that regulates solid and hazardous waste.

Respiration. The metabolic processes by which an organism takes in and uses oxygen and releases carbon dioxide and other waste products.

Revised Code of Washington. The compilation of the laws of the State of Washington published by the Statute Law Committee.

Runoff. Runoff is the liquid fraction of dredged materials or the flow/seepage caused by precipitation landing on and filtering through upland or nearshore dredged material disposal sites.

Salmonid. A fish of the family Salmoniidae. Fish in this family include salmon and trout. Many Puget Sound salmonids are anadromous, spending part of their life cycles in fresh water and part in marine waters.

Sediment. Material suspended in or settling to the bottom of a liquid, such as the sand and mud that make up much of the shorelines and bottom of Puget Sound. Sediment input to Puget Sound comes from natural sources, such as erosion of soils and weathering of rock, or anthropogenic sources, such as forest or agricultural practices or construction activities. Certain contaminants tend to collect on and adhere to sediment particles. The sediments of some areas around Puget Sound contain elevated levels of contaminants.

Site Condition. The degree of adverse biological effects that might occur at a disposal site due to the presence of sediment chemicals of concern; the dividing line between "acceptable" (does not exceed the condition) and "unacceptable" (exceeds the site condition) adverse effects at the disposal site. Other phrases used to describe site condition include "biological effects condition for site management" and "site management condition."

Spot Checking. Inspections on a random basis to verify compliance with permit requirements.

State Environmental Policy Act. A State law intended to minimize environmental damage. SEPA requires that State agencies and local governments consider environmental factors when making decisions on activities, such as development proposals over a certain size. As part of this process, environmental documents such as EIS's are prepared and opportunities for public comment are provided.

Statistically Significant. A quantitative determination of the statistical degree to which two measurements of the same parameter can be shown to be different, given the variability of the measurements.

Subtidal. Refers to the marine environment below low tide.

Suspended Solids. Organic or inorganic particles that are suspended in water. The term includes sand, mud, and clay particles as well as other solids suspended in the water column.

Target Area. The specified area on the surface of Puget Sound for the disposal of dredged material. The target area is within the disposal zone and within the disposal site.

Toxic. Poisonous, carcinogenic, or otherwise directly harmful to life.

Toxic Substances and Toxicants. Chemical substances, such as pesticides, plastics, detergents, chlorine, and industrial wastes that are poisonous, carcinogenic, or otherwise harmful to life if found in sufficient concentrations.

Treatment. Chemical, biological, or mechanical procedures applied to an industrial or municipal discharge or to other sources of contamination to remove, reduce, or neutralize contaminants.

Turbidity. A measure of the amount of material suspended in the water. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. Very high levels of turbidity can be harmful to aquatic life.

Unconfined, Open-Water Disposal. Discharge of dredged material into an aquatic environment, usually by discharge at the surface, without restrictions or confinement of the material once it is released.

Variable Range Radar. Radar equipped with markers which allow measurement of bearings and distances to known targets.

Vessel Traffic Service (VTS). A network of radar coverage for ports of Puget Sound operated by the Coast Guard to control ship traffic. Most commercial vessels are required to check in, comply with VTS rules, and report any change in movement.

Volatile Solids. The material in a sediment sample that evaporates at a given high temperature.

Washington Administrative Code. Contains all State regulations adopted by State agencies through a rulemaking process. For example, Chapter 173-201 WAC contains water quality standards.

Water Quality Certification. Approval given by Washington State Department of Ecology which acknowledges the compliance of a discharge with Section 401 of the Clean Water Act.

Waterways Experiment Station (WES). Corps of Engineers (Corps) research facility located in Vicksburg, Mississippi, that performs research and support projects for the various Corps districts.

Wetlands. Habitats where the influence of surface or ground water has resulted in development of plant or animal communities adapted to such aquatic or intermittently wet conditions. Wetlands include tidal flats, shallow subtidal areas, swamps, marshes, wet meadows, bogs, and similar areas.

Zoning. To designate, by ordinances, areas of land reserved and regulated for specific land uses.

ABBREVIATIONS

AET. Apparent Effects Threshold.

CFR. Code of Federal Regulations.

Corps. U.S. Army Corps of Engineers.

CWA. The Federal Clean Water Act, previously known as the Federal Water Pollution Control Act.

DEIS. Draft Environmental Impact Statement.

DMRP. Dredged Material Research Program.

DNR. Washington Department of Natural Resources.

DSS TA. Disposal Site Selection Technical Appendix.

DSWG. Disposal Site Work Group.

Ecology. Washington Department of Ecology.

EIS. Environmental Impact Statement.

EPA. Environmental Protection Agency.

EPTA. Evaluation Procedures Technical Appendix.

EPWG. Evaluation Procedures Work Group.

FVP. Field Verification Program.

HPA. Hydraulics Project Approval. RCW 75.20.100.

ML. Maximum Level.

MPTA. Management Plans Technical Appendix.

MPWG. Management Plan Work Group.

NEPA. National Environmental Policy Act.

PAH. Polycyclic (Polynuclear) Aromatic Hydrocarbon.

PCB's. Polychlorinated Biphenyls.

PMP. Proposed Management Plan.

PSDDA. Puget Sound Dredged Disposal Analysis.

PSEP. Puget Sound Estuary Program.

PSIC. Puget Sound Interim Criteria.

PSWQA. Puget Sound Water Quality Authority.

RAD's. Regional Administrative Decisions.

RCRA. The Resource Conservation and Recovery Act.

RCW. Revised Code of Washington.

SEPA. State Environmental Policy Act.

SL. Screening Level.

SMA. Shoreline Mangement Act.

WAC. Washington Administrative Code.

WES. Waterways Experiment Station.

401. Section 401 of the Clean Water Act.

404. Section 404 of the Clean Water Act.

4MR. The Fourmile Rock DNR disposal site in Elliott Bay.